W. Windham

By Andrew Porter

John M. Potter
June 1875
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MATHO:

OR, THE

Cosmotheoria Puerilis,

A

DIALOGUE.

IN WHICH

The first Principles of PHILOSOPHY and ASTRONOMY are accommodated to the Capacity of young Persons, or such as have yet no Tincture of these SCIENCES. Hence the Principles of Natural Religion are deduced.

Translated, and enlarged by the AUTHOR.

In TWO VOLUMES.

To which is added, a complete INDEX.

Nam corpus hoc animi pondus & pœna est: Premente illo urgetur, in vinculis est, nisi accessit Philosophia, et illum restituere rerum naturæ spectaculo jussit——Vetas me cœlo interesse, id est, jubes me vivere capite demisso. Seneca.

The SECOND EDITION,

LONDON:

Printed for A. MILLAR, over-against *Katharine-Street* in the *Strand.*

MDCCXLV.

TO

Master *GLOVER*,

Son to PHILIPS GLOVER

OF

Wiſpinton, Eſq; in *Lincolnſhire*.

SIR,

I Here preſent you with a * *Tranſlation*, the *Original* of which was wrote for a young Gentleman much about your Age. The Progreſs You

* What the Author here calls a *Tranſlation* contains ſix or ſeven Times more Matter than the *Original*, which was only a Pamphlet of eight or nine Sheets.

and he ſhall make in theſe Things, will beſt ſhew me how I have executed the Deſign. It is reaſonably ſuppoſed by good Judges, that Youth is better qualified to learn, than we are aware of; or really than Men are to teach. True Knowledge has, indeed, been wrapt up in ſuch a myſterious Dreſs, as if it were deſigned to diſcourage young Perſons from attempting it. How I came to make a Trial what a contrary Method might do, would require more Words to ſhew, and apologize for, than is proper to give you the Trouble of Hearing.

If

If I have rightly profecuted the Plan I propofed, what is firft brought in View will fuit your Humour at prefent, and what follows will ferve to amufe you when farther advanced. But if upon Experience, the whole fhould be found of little Ufe, as it may be thrown afide, it can do no Harm.

You ought to know, Sir, that it depends in a great Meafure on thofe of your Age and Fortune, fo to lay out your early Years, as to make the rifing Generation virtuous, by the Authority of your Examples afterward. Your Amufements therefore are of more

Conſequence to the World than what is commonly imagined. This, beſides your own private Advantage, is the moſt noble *End* you could poſſibly aim at; and will, I am perſuaded, fire you with a Reſolution of being among the foremoſt in the Purſuit of Knowledge, and Practice of Virtue, which are naturally allied to each other.

I am with great Zeal,

Sir,

Your moſt faithful,

Humble Servant.

TO THE

READER.

THE first great Objection against the following Performance will be, that Matho *is made to speak above his Years: But in this Case we should, I think, moderate the Rigour of Criticism a little. The Design of Writing for the Use of young Persons can only be, that they may understand what is said, though they should not be able at first to say the Things themselves: If they could say the same Things there would be no Occasion of Writing for their Use. In the Books, which are first put into our Hands when we go to School, Children are made to talk* Latin *prettily; not that Children can talk so, but that by Reading those Things they may learn to talk so: And perhaps before a young Gentleman can talk as fine* Latin, *as Children are supposed to do there, he may be brought to think as justly as* Matho *is supposed to do here. After all, there is no common Standard in this Case; the same Difference may be observed between young Persons of thirteen or fourteen, as between Men of thirty or forty. If I have been so for-*

tunate as to make it appear natural, that a young Gentleman might enter eaſily into the Subjects diſcourſed upon, by repreſenting them in a familiar Way, that will be the beſt Apology: But every Reader will be a better Judge of this than I am; and a young Reader a better Judge than one who knows the Things already, by the learned Methods of treating them.

There will, no Doubt, be other Objections, which I dare not pretend to anſwer; but muſt refer myſelf to the Indulgence of the judicious and candid Reader, who will beſt ſee the Difficulty of ſuch an Undertaking. A firſt Attempt *of this Nature muſt be many Ways imperfect: Yet, I think, the Method may be of ſuch Advantage, that it is worth While to make a Trial, and even that at the Hazard of Miſcarrying.*

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theſe

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MATHO:

OR, THE

Cosmotheoria Puerilis,

A DIALOGUE, &c.

The first Meeting.

Matho, *a Boy of a fine Genius, desires his Friend* Philon *to explain, and, if possible, bring within the reach of a Boy's Capacity some things in Philosophy, concerning the Heavens and the Earth; such, to wit, as were most necessary to be known, and likewise pleasant: That those of his Age might the sooner accustom themselves to the Contemplation of Truth, and the Study of Nature, instead of passing the first Stage of their Lives in the Study of Words only: Whereupon they enter on the Consideration of the spherical Figure of the Earth, and the Nature of Gravity.*

MATHO, PHILON.

M. I Am glad, *Philon*, I have met with you. The first Conference.

P. Upon what Account, *Matho?*

M. There are some things I am very desirous of knowing, nor have I Confidence to address myself to any other Person than you, of whose Friendship I have had so many Proofs.

The first Conference.

P. If I can assist you in any thing, you may be assured of my Inclinations.

M. But perhaps I may be troublesom to you with my childish Fancies.

P. You cannot be troublesom to one who is glad to serve you; and besides, the Matter seems to be of Consequence.

M. To me it is, if that were enough to make you think it deserved your Attention.

P. It shall be enough, I assure you, to make me think it worth my most serious Attention.

M. Tell me therefore, *Philon*, in the first place, could you bring down some part of your Knowledge to my Capacity?

P. I cannot tell that; but this I can assure you, that I'll do my best to make you understand in some measure any thing I know my self. But you seem to have conceived much too high an Opinion of my Knowledge.

II. *M.* My Father, and several of our Friends, frequently tell me I am troublesom with my idle Questions: Wherefore they either send me away with a Joke, or bid me mind my Grammar and Parts of Speech for some time, and not meddle with philosophical Matters, till I am six or seven Years older; for that these Subjects cannot be understood till one has attained to seventeen or eighteen Years of Age. Now I should be glad to know, if there may not be a Method of teaching *Boys* what they are fond of learning; or if any one can have a Curiosity to know what he has not yet a Capacity to understand? *P.* Cer-

The first Conference.

P. Certainly, *Matho*, an earneſt Deſire of knowing any thing promiſes a Readineſs of Conception; becauſe an Uneaſineſs under Ignorance quickens the Apprehenſion, and makes the Mind attentive to catch any Hint: But notwithſtanding this, you muſt begin with the firſt Principles of Things, and ſuch as are neceſſary to lay a right Foundation; for moſt People are deſirous to be taught, but cannot beſtow the neceſſary Application.

M. You even increaſe the Earneſtneſs of my Deſire, ſince I find you are of the ſame Opinion with myſelf. However, though perhaps I may not yet be capable of comprehending the Reaſons of many Things, I would nevertheleſs know the Things themſelves as they are: There being a great Difference, as I think, between having one's Head ſtuffed with the ſilly Notions of the Vulgar, and having firſt been told the Truth of the Caſe, as it really ſtands.

P. Nor is it indeed Matter of Difference, *Matho*, whether *Truth* or *Error* firſt takes root in the Minds of Men. Wherefore the plain and ſimple Truth is to be laid open to young Perſons, as ſoon as they begin to turn their Thoughts on any Subject; and the Point is to be illuſtrated, when it can be done, with ſuch familiar Compariſons as ſuit their Age, or have fallen under their Obſervation. For unleſs the Mind is thus early tinctured with Truth, they naturally fall into abſurd Notions concerning whatever they obſerve; and contract ſuch Prejudices as they are ſcarce ever able to get the better of.

The first Conference.

M. You will therefore give me your Assistance in this Affair, on a double Account; both to help me to avoid this Inconvenience, and also to relieve me from a present Uneasiness: Wherefore leaving farther Preambles, I shall freely tell you the Things which frequently occur to my Mind, and often perplex my Thoughts.

III. I see the Heavens over my Head, and tread on the Earth with my Feet; but I am at a Loss what to think of that *mighty Concave* above me, or even of this very Earth I walk upon. I often think whether the Earth may not stretch out in breadth to Immensity, so that if one was to travel it over, one should never be able to get to the *end* of the Earth, but always find room to continue the Journey: Nor can I satisfy myself as to the Depth of the Earth, whether it hath any Bottom: and if so, what it is that can be below the Earth. As to the Heaven, I need say nothing: Every Change that happens, and every Object seen there, perplexes me with Doubts and fruitless Guesses. I often wonder how the Sun moves over so large a Space every Day, and yet seems not to stir out of its Place. I would know where he goes beyond the Mountains in the Evening; what becomes of him in the Night Time; whether he makes his Way through the Thickness of the Earth, or the Depth of the Sea, and so always shews himself again from the East the next Morning. It seems strange that being so small a Body as he is, he should be seen every where, and

still

The first Conference.

ſtill of the ſame Bigneſs. The various Nature of the Moon ſeems yet more perplexing: To Night perhaps you can ſcarce diſcern her: but in a few Days ſhe becomes larger than the Body of the Sun itſelf: In a little time after ſhe decays, and at laſt wears quite away; yet ſhe recovers again. In a word, ſhe is never the ſame, and yet ſtill becoming what ſhe was before. What means that Multitude of Stars ſcattered over the Face of the whole Sky, whoſe Number is ſo great that it is become proverbial!—There are other things, *Philon*, I want to be informed of; but theſe are the main Difficulties, which exerciſe my Thoughts, and perplex my Mind with endleſs Doubting. We are bid to be ſilent with our Doubts concerning theſe Matters, which chiefly ſtrike a Boy's Mind with Admiration, and raiſe his Curioſity: We are bid to be content with our Ignorance for not a few Years, till we become as it were habituated to a Want of Knowledge; till the uneaſy Senſe ariſing from Curioſity, and unſatisfied Deſire, has loſt it's Edge.

IV. *P.* You have reckoned up a good many Particulars, *Matho*, of which ſome are more difficult to be known than others: Of ſome of them even Men themſelves are yet ignorant, ſo that thoſe of your Age cannot be ſuppoſed to know them. However, I am not without Hopes but that you may receive ſome ſort of Satisfaction as to the greateſt part of your Doubts. But what Boy of a thouſand is it, to whom his Ignorance in theſe points gives the leaſt trouble?

The first Conference.

M. Forgive me, *Philon*, you have perhaps been ſo earneſt in your Purſuits, ſince you became a Man, that you have forgot what paſt in your Mind when you were a Boy. We are ſometimes cloyed even with our own Diverſions, and ſeek Relief from ſomething elſe: We walk then by two's or three's, or lye down perhaps upon the Graſs. At thoſe Times the Heavens offer themſelves to our Eyes and Minds, when thus unoccupied with any thing elſe; our Ignorance creates our Wonder, and we are under no Reſtraint in diſcovering our Thoughts to each other. Every Thing is a Difficulty to us, and we endeavour to ſolve our Doubts by Conjectures, which are certainly ridiculous enough, if you Men were to over-hear them.

P. And yet I obſerved you ſaid ſomething juſt now, while you were telling me your Difficulties, which looked like Obſervation and Experience.

M. Pray what was it?

P. How do you know *that the Sun, being*, as you ſay, *ſo ſmall a Body, does appear every where of the ſame Bigneſs?*

M. Why, we compare our Reaſons together, and ſometimes help one another out. One obſerves that a Houſe, if it were at ſeven or eight Miles Diſtance, could ſcarce be ſeen, or at moſt appear but very ſmall: Some of us have been at thirty or forty Miles Diſtance in the Country; we find the Sun appeared juſt as big there as here: And yet the Sun ſeems by no means ſo large as a Houſe. This ſeems ſtrange to

us;

us; for on enquiring we have the same Account from all our Comrades.

P. Very good, *Matho*, I hope your Doubts may be so much the more easily satisfied, as you are thus solicitous to have them removed. It is a Happiness where the Desire of Knowledge becomes a sort of Disease; for then we greedily listen to the Reasons of Things, as affording us a proper Remedy for this Uneasiness of the Mind.

V. As to the Earth, that we may begin from thence, it is neither stretched out into an immense Breadth, as you imagined, nor is it deep without Limits, but bounded on all Sides; and is nearly of a spherical Figure.

M. You mean it hath a round Figure like that of a Globe, or that perhaps the Earth itself is a huge Globe.

P. That is my Meaning.

M. How, I pray, is that known? For this round Figure of the Earth would remove my Difficulties, as to its infinite Breadth, or bottomless Depth; but it raises other Doubts no less perplexing to one's Mind.

P. What are they?

M. How can the Earth, if thus bounded, and detach'd from every thing else, rest without something to support and keep it up? Why doth it not fall downward? By what Force do the *under-parts* of it stick close to the *upper*?——

P. Suspend a little, if you please, your Enquiry into the Reasons of Things, or *why they are* so, till you are once certain of the Facts, or

The first Conference.

that they are really so. Wherefore tell me, *Matho*, have you never heard that the Globe of the Earth hath been sailed round?

M. I have indeed heard this in Discourse, but did not understand the Meaning of that *sailing round:* I imagined it might be as when a Man is said to *ride round* a Country, or *walk round* a Field.

P. Well, but if a Ship should set sail from a Port, steering westward, and still keeping on the same Course, should return again from the East into the same Port whence she had set out, what would you think of the Figure of the Earth from *such sailing round?*

M. If indeed the Ship still kept the same Course, and yet returned, from the opposite Side, into the Harbour whence she had first set sail, she must, I think, have gone round the whole Circuit of the Earth. For, (if I may explain my Conceptions of this Matter by a low Comparison) it is as if some little Reptile, an *Ant* for Instance, should travel round a wooden Bowl in her creeping Pace, going off toward the right Hand, and returning from the left.

P. Your Comparison expresses the Case clearly, and contracts the tedious Voyage of the Ship into the shorter Journey of the little Insect. But if the Earth were either endlessly broad, or deep without bottom; or if it rested on any thing as a *Basis* or *Support*, and that *Thing* upon another, and so on; if, I say, that were the Case, could the Earth, think you, be sailed round? or the Ship return from the opposite side into the same Port?

M. In

The first Conference.

M. In that Case, indeed, I do not see that either the Ship could return into the same Port, or the Sun himself go round such an immense, shapeless Earth, to the East again, as he does every Morning. But possibly the Earth may be round only about the middle parts of it, that is, towards the *East* and *West*, so that it might be sailed quite round there, while it runs out in length toward the *South* and *North*.

P. How far would you have it to run out that Way?

M. I cannot tell.

P. It is the Intenseness of the Cold only, *Matho*, about the *Poles* of the Earth, as they are called, that hinders Navigators from sailing round the Earth that Way also; and not the Figure of the Earth at all: For if we travel to a considerable Distance, either southward or northward, still new Parts of the Heaven are discovered, and seem to rise higher before us, while the Parts behind us seem to sink down, and fall under the Earth; which could not happen, if the Earth extended infinitely South and North: Nay, on the contrary, which may perhaps seem strange to you, the Globe of the Earth is more plain about those parts, than about the Middle of it.

M. You mean it is flatter, or less protuberant about those Poles.

P. That is it.

M. It may be so; but let me consider a little with myself, if I can apprehend the Force of this second Argument,—It seems to be, as if the

The first Conference.

the little Insect I mentioned just now should proceed, not from the right Hand towards the left, but creep straight forward in a middle Path betwixt both; for then it would discover some new Parts before itself, and lose Sight of others behind, in the same manner as if it moved in the cross Track.

P. You have it exactly: And hence it is that the Star, which is called the *Pole-Star*, is raised higher to us, if we travel northward, and falls lower if we go the contrary Way; sinking gradually as we advance toward the South; for then a greater part of the Earth's Convexity comes between it and us: Thus it appears to be raised higher to us in *Britain*, than to those in *France* and *Italy*, as our Country lies more northward.

M. I conceive it from the Example above: Therefore, if the Cold would allow us still to advance northward, the Pole-Star would at length appear directly over our Heads; and on the contrary, by still retiring towards the South, it would gradually seem to approach towards the Earth, and at last sink below it.

P. You are perfectly right.

VI. Now from both Arguments put together, (that, to wit, which shews the Earth to be round from East to West, and that which shews it to be round from South to North) what Sort of a Figure must it have, do you think?——

M. But is it certain that it hath been thus sailed round? *P.* It

P. It is beyond all Question; the *English*, *Dutch*, *Spaniards*, *French*, &c. have often sailed round the Globe of the Earth: Nor hath the Voyage for many Years back been reckoned a Matter of great Difficulty. The first Conference.

M. A Thing then so often performed, cannot, it seems, well be denied.

P. Certainly it cannot, unless we would expose ourselves by a ridiculous doubting of plain Fact; nor therefore can we deny that which is as certain as this Navigation itself.

M. What is that, I pray you?

P. That those Navigators, while they were in the opposite Part of the Globe, beheld the Heavens over their Head, and saw the Sun and Stars perform their Courses, the same Way as in their own Country: For in all Parts *Night* and *Day* regularly succeeded each other.

M. The Heavens therefore surround the Earth on all Sides, it seems.

P. Undoubtedly.

M. And the Sun by Night shines to other Mortals.

P. It is so; for when he sets to us, which you agreeably enough called *going behind the Mountains*, he rises to other Parts of the Earth. And where-ever he appears he makes it *Day* by his chearful Rays spread on that Part of the Globe, while the opposite Side is covered with *Night* and Darkness.

M. The Sun then must move round the whole Earth every Day.

P. He seems at least so to perform his Course from East to West. *M.* What,

The first Conference.

M. What, *Philon!* doth he not really perform this Course?

P. How Things are in Reality you will see afterward: Therefore suspend your Judgment at present, till Arguments determine you to one Side.

VII. *M.* I shall endeavour to obey you; However, be that as it will, you have not yet removed my Difficulties: For tell me, are there any Inhabitants in the Part of the Earth just opposite to us?

P. There either are, or at least may be Men directly opposite to us.

M. They walk then with their Heads hanging downward; in which case what can hinder them from falling down altogether?

P. How would you, *Matho*, answer that Question, if those Men argued thus concerning you? For they have the very same Reason to be afraid lest you should fall off from the Earth.

M. It cannot be that any one should *fall upward*, or towards Heaven; that would be to be *raised on high*, not to fall downward.

P. Very right; now they can give the same Reason, *viz.* That they could not *fall upward*, or towards Heaven; since that could only be by being raised on high, which you say is not *falling*. And since the Heaven is over their Heads, as much as it is over ours, to fall from their Part of the Earth would be to be carried aloft, as much as it is here with us. In a Word,

a Word, towards the Earth is *downward*, and towards the Heaven *upward*, on whatever Part of the Globe we stand. The first Conference.

M. I know not well what to say to this; I have nothing to object to your Argument; and yet it doth not convince me.

P. It frequently thus happens, *Matho*; Prejudices which we take early up are not to be overcome in an instant, especially if the Point be such as we conceive impossible to be otherwise than it appears to us. But tell me, do you allow that a Ship may sail round the Earth?

M. Why should I not allow a Thing which Experience shews to be matter of Fact?

P. Why therefore are you not afraid lest the Ship, while she is in the opposite Part of the Ocean, should fall out of the Sea? Or rather, why do you not suppose that the Water of the Sea itself should fly off to the Clouds, Ship and all together?

M. Indeed I think there would be Danger of it: And since it does not, I want to know the Cause.

P. What is it that hinders a Ship in this Part of the Globe from falling from the Sea up to the Clouds?

M. Her Weight.

P. And whither doth her Weight tend?

M. Towards the Earth.

P. Right: Now the Weight of any Thing tends toward the Earth, even at the *Antipodes*; for so they are called who have their Feet oppofite to ours.

M. You

The first Conference.

M. You say then that their Weight carries heavy Things towards the Earth, *all round the Earth*; and therefore as much at the Antipodes as here?

P. I say so; and Experience shews this to be Fact, whatever the Cause of it may be.

M. And that therefore to tend toward the Earth is to *tend downward*, on whatever Part round the whole Earth the heavy Body be placed?

P. Certainly.

M. Nor can we say, if we would speak accurately, that the Antipodes are below us, more than that we are below the Antipodes?

P. Surely we cannot: For if it requires a Force to raise a Stone, or any other Thing from the Earth, *there* as well as *here*; and if it falls back when left to itself, there as well as here; they must say as properly *it falls downward* there, as we say here. And you cannot suppose that our Mariners, when in the opposite part of the Ocean, feel less Difficulty in raising a Weight, than here in *Britain*; or that it would not fall back upon them, if left to itself.

M. Indeed, I see I cannot.

P. No Side of the Globe then can claim the Privilege of being the *upper Side*, or reckoning the opposite Part the *under Side* of the Earth.

M. I perceive now, that would be foolish, and seem to myself to have got a better Notion: So that if I were in those Parts, and arguing with some unskillful Boy like myself, who supposed

posed that *we here* were in Danger of falling from the Ground towards the Clouds, I could shew him, that he was in Pain for *us* as needlessly as I had been for *them*, since our Weight pressed us both equally to the Earth.

P. The Reason certainly is the same in both Cases.

M. Nay, I believe I could hardly forbear laughing at his simplicity; as if we did not walk as securely on the Ground here, as they do there. Which I see now would be in effect only laughing at my self, and the silly Notions I had just a few Minutes ago.

P. It is not amiss, *Matho*, to suppose sometimes, that we have thus changed Sides in the Question; for we more easily perceive our Mistakes, when they are supposed to belong to another Person.

VIII. *M.* But tell me, which is the *lowest Place* of all, below which nothing can be?

P. Now you begin to be too accurate, *Matho*; but you yourself will easily see, that the middle Point between us and the Antipodes, that is, the very center of the Earth, is the lowest Point of all; at least with respect to us.

M. For this Reason, I suppose, because if there were a Passage to the Center of the Earth, a heavy Body falling down would be said to *descend* thus far; and if it could go beyond the Center, it would begin to *ascend* again, or rise up towards the opposite Surface.

P. You

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P. You are perfectly right.

M. But because there is no Passage to, or from the Center, whatever rises straight upward from the Surface of the Earth, either here with us, or at the Antipodes, or in any Part round the whole Globe, is said to *ascend*, as if it rose from the Center or lowest Point.

P. That is, indeed, the very Reason: For any thing, by receding from the Surface, must recede from the Center at the same Time, or increase the Distance between the Center and itself.

M. Thus far I understand then, that heavy Bodies, by tending to the Surface on all Sides, must therefore tend also the Center.

P. And hence it is that Water, which is both heavy and fluid, seeks always to a lower place, till it can get no farther.

M. But pray tell me, *Philon*, what is the Cause why heavy things tend to the Earth, even from opposite Sides of it, and by Motions contrary to each other? For from what you have already shewn me, it follows, that if there were a Hole through the whole Thickness of the Earth, as far as the Antipodes, and if two Stones were let down at the same time, one from our Side, and another from the opposite Mouth of the Hole, they would, by the same Gravity impelling them, run opposite to each other, and encounter at the Center.

P. Indeed, *Matho*, if you go on at this Rate, I'm afraid I must bid you farewell.

M. Why so, dear *Philon!*

P. Lest

The first Conference.

P. Lest I should be forced to own my Ignorance.

M. I wish I were able to bring you to that pass.

P. I am not very far from it already.

M. I see well enough, *Philon*; what is the Meaning of this; you think that I could not understand the Cause of this Gravity of Bodies.

P. On my Word, I had no such Thought: But I foresee you will lead me very deep into these Matters.

M. We are at the Center of the Earth already: We can go no deeper than that Point.

P. You are disposed to be pleasant, *Matho.*

M. To be serious then; if you would complete your Favour to me, tell me the *true Causes* of Things, as well as the *Things themselves*. If I should not be able to comprehend them, you will lose only a little Labour: But if I should chance to understand any Thing, that will be a considerable Gain to me.

P. Well, but let us first consider for a little, from some parallel Case, how Bodies thus tend to the Earth: That perhaps will bring us nearer the true Cause, and we may resume the Question at some other Time. Wherefore,

IX. Tell me; did you ever see a *Load-Stone?*

M. Not once, but often; and have frequently tried, by way of Diversion with my Comrades, the strange Virtue it has.

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P. You have obſerved it then to draw the *Iron* to itſelf?

M. Yes; and when it had brought it cloſe, it kept it there; ſo that it required ſome Force to ſeparate them again.

P. But did the Load-ſtone only attract the Iron in this Caſe?

M. Nay, the Iron drew the Load-ſtone with equal Strength, as it appeared to us: For if the Key, with which we made the Trial, were kept from moving towards it, the Load-ſtone came over the whole Diſtance between them, and applied itſelf to the Key, ſometimes one way, and ſometimes another.

P. There are indeed ſome Singularities in this Affair; but the Iron and Load-ſtone attracted each other mutually?

M. That ſeems to be the Caſe indeed: And certainly it is a moſt ſurpriſing Sight!

P. And yet ſcarce any thing is more common than ſuch a Sight.

M. How! ſuch a Sight as that common?

P. Did not you yourſelf obſerve juſt now, that two Stones, let down from oppoſite Parts, would ruſh violently to each other through the whole Thickneſs of the Earth? And that any Sort of Bodies, if there were a Paſſage for them thither, would run on till they met at the Center of the Earth? In ſhort that all heavy Bodies move directly to that Point, as far as they are allowed to move; ſince they move directly to the Surface of the Earth; of which

various

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various Motion from all different Parts, you so earnestly desired to know the Cause?

M. How thoughtless I am! But your mentioning the Load-Stone had put the Earth quite out of my Head.

P. Well then, is it any Thing less wonderful, do you think, that all Bodies round us should so violently rush towards the same Point, than that the Iron and Load-Stone should move to each other?

M. Truly, when I consider the Matter seriously, I think it is no less wonderful; or rather that it is the same Wonder ten thousand Times repeated. I know not how it comes to pass, but we never think at all on the Subject.

P. Think of it then at your Leisure.——

M. I find I can make nothing out by thinking. If all Bodies moved the same Way, such Motion might appear natural to them: But when they rush directly against each other, how can that be natural?

P. You go rightly to work, *Matho:* It is a great Point gained, *to get a sight of the Wonder*; to be awakened from that supine Thoughtlessness which makes the Gross of Mankind look on *Things astonishing* with Indifference, because they see them constantly. Nor is there any thing in Nature more astonishing than this common Sight: For, that I may observe thus much to you by the way, This Action in Bodies of rushing so violently all to one Point, which we call *falling*, is not the Action or Effect of Matter itself.

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M. Of what other Thing then is it the Action?

P. Of what Thing do you think?

M. Of something certainly that is not Matter.

P. You have hit on a right Distinction; wherefore let me earnestly beseech you, *Matho*, never to forget it.

M. I do not see the great Merit of hiting on a Distinction which was unavoidable: For if this Thing, which produces the Action of falling in Bodies, be not Matter itself, it must necessarily be something different from Matter. But since you so earnestly desire me to remember it, I shall suppose something of Importance is concealed under your Request; so there will be no Danger of forgetting it.

X. *P.* Leaving it therefore at present, tell me, if there were many different Particles of Iron scattered up and down, would they not all, think you, meet together from the opposite Parts round about, by Means of the Magnet attracting them?

M. It seems probable they would *; for they must yield to that Force which moves a greater Quantity.

* *Des Cartes* has a curious Experiment of this; but draws a wrong Argument from the Appearance. *Si paullo curiosius consideramus, quo pacto limatura ferri circa magnetem se disponat, multa ejus ope advertemus, quæ hactenus dicta confirmabunt, &c.* Princip. Part. IV. §. 179.

P. And

P. And if there were two or more Load-Stones, would not they likewise draw each other? The first Conference.

M. I suppose they must †; and it is reasonable to think that their Force would be increased by their Number.

P. If then we should suppose the Magnets and Particles of Iron to be multiplied to any Number, or increased to any Quantity; what do you think would be the result?

M. They would all, I suppose, meet and make up one Magnitude or Bulk, which would afterwards stick close together by the same Force that brought the Parts first into Contact: For the Key and Load-Stone never part, till they are forced asunder.

P. What if any Particle of this Bulk were by some external Cause disjoined from the rest?

M. I imagine it would fall back again, the rest by their united Power retracting it.

XI. *P.* Observe how much you have granted me.

M. I do not well know what you mean by this.

P. Consider with yourself a little, whether what we have been speaking of just now might not be applied to make you conceive what we were speaking of before, concerning heavy Bodies moving towards the Center of the Earth.——

† See *ibid.* §. 152.

The firſt Con-

M. Now indeed I perceive what it is you intend. You mean that the Earth attracts to itſelf all Bodies in the ambient Space; and is mutually attracted by them: Juſt as the Magnet draws, and is drawn by the ſmall Particles of Iron.

P. If then all the Parts of this our Earth were endued with ſuch a Power of mutually attracting each other; do you think there would be need of any other *Support*, or *Foundation*, on which the Weight of the whole might reſt?

M. Let me conſider this Queſtion a little, before I pretend to anſwer it.——You ſay, *If all the Parts of the Earth were endued with ſuch a Power of mutually attracting each other.* I ſee plainly by their falling back, that the Earth attracts Bodies raiſed to any Height from it; but it is not ſo plain that *all* the Parts of the Earth attract each other, when they are at reſt in the Earth itſelf.

P. Reflect a little, *Matho*; does not the ſame Attraction, that draws Bodies back to the Earth, keep them ſtill at reſt there, juſt as it is in the Particles of Iron ſticking cloſe to the Magnet, which you yourſelf obſerved?

M. Pardon this Inattention: I ſee it muſt be ſo.

P. Have not all Bodies Weight, as much when they lie on the Ground, as when they are hanging in a Balance?

M. They

M. They have; otherwise it should require no Force to raise them from the Ground.

P. Is what we call *Weight* or *Gravity* in Bodies, any other Thing than the constant Force of this Attraction?

M. It is nothing else but the Force that draws them back to the Earth, and keeps them there.

P. Can you suppose that any Bodies through the whole Mass of the Earth have no Weight?

M. I conceive they all have Weight, since it would require a Force to raise them from the Place they are in.

P. If then Weight be nothing but the constant Force of Attraction; and if all Parts through the whole Mass of the Earth have Weight; is it not the same as to say that all the Parts of the Earth are attracted?

M. There is no denying it.

P. But if each Part be attracted, must it not be attracted by the rest?

M. Certainly it must.

P. And if this be true of every Part separately (that it is attracted, and attracted by the rest) will not that shew, that every Part is both *attracted*, and *attracts* the rest?

M. This Question is too intricate for me to see through.

P. In this Case you may suppose the Parts to be great or small: Now if you conceive the Earth to consist only of two Parts, will not each half attract the other, and be attracted by it?

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M. Without Doubt.

P. And if you conceive three Parts in it only, will not each attract, and be attracted by the other two?

M. That is equally plain.

P. Juſt ſo, if you ſuppoſe only four Parts in the Earth, any one of them is attracted by the other three; and any three of them join to attract the fourth.

M. I perceive now the Method; you may go on at this Rate for any Number of Parts poſſible, ſtill proving that any one attracts all the reſt, and is attracted by them. And truly it is wonderful that any the leaſt Particle of Matter in the Earth ſhould attract all the reſt, let them be as many as can be imagined.

P. I am glad, *Matho*, this Obſervation did not eſcape you; the Thing is not only wonderful, but *aſtoniſhing*: Nor was it ſtrange that you did not perceive, at firſt View, what requires Exerciſe and Variety of Thought to be rightly apprehended. Let me alſo aſk you this Queſtion, which may perhaps give you another View of this Particular: Can any Body be attracted by another, and not mutually attract *that* by which it is attracted?

M. I do not really ſee the Neceſſity why a Body by being attracted ſhould attract; and yet I believe it muſt be ſo, from what you have ſaid above.

P. Take it thus then: Can a Body adhere or cleave to any other Body, and yet that other not adhere to it?

M. I

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M. I see the Necessity in this Case.

P. But do not Bodies adhere to each other by the same Force that first brings them together?

M. They do.

P. Then a Body cannot be attracted without attracting, nor attract without being attracted. If the contrary were possible, it would require some Degree of Force to separate the *attracted Body* from the other, since it was drawn by a certain Force: And yet it would require no Degree of Force to separate *that other* from it, because that was drawn by no Force: That is, it would require Force to separate the Iron from the Magnet, but no Force to separate the Magnet from the Iron.

M. That is both absurd in common Sense, and false in Fact. And thus I see that any the least Particle, by being attracted by the whole Bulk of the Earth, must *necessarily* attract that whole Bulk, or every individual Particle in it: Which again surprizes me to consider how *manifold* the *Action* must be from any one Particle, to an inconceivable Number of other Particles. And I am satisfied already that such *manifold Action* cannot be the *Work* of the little Particle itself.

P. You prevent me agreeably, *Matho*, in making the proper Observations as we go along. But tell me, is not the attracting of the whole Earth the united Attractions of all its Parts?

M. It

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M. It is, as much as the Weight of any Body is the united Weight of all its Parts: For as Weight does not differ from Attraction, ſo neither does the Earth differ from all its Parts.

P. If the Earth then had but half as much Matter in it, (or half as many Parts) would our Bodies be equally heavy towards it, as at preſent?

M. They muſt certainly be much lighter.

P. And if it had twice as much Matter, would the Gravity of Bodies be the ſame?

M. They ſhould be much heavier.

P. Can Gravity or Weight therefore belong to Body itſelf; which may be thus leſſened or increaſed, without any Change of Matter happening to the Body?

M. I ſee clearly it cannot, and that the *Action of falling* is not the Action of the Stone that falls.

P. But may it not be ſuppoſed to be the Action of the Matter of the Earth, towards which the Stone falls?

M. It cannot, if the Obſervation which I made juſt now, and which you likewiſe approved of, be right: For the ſmall Particles, of which the Maſs of the Earth conſiſts, cannot conſpire from *all Places*, towards every *particular Place*, to produce Gravity in every Thing that falls, nay, in every Thing that hath Weight. To ſuppoſe *every Particle* acting *every way* is inconceivable. Such manifold and diſtant Actions, as I ſaid, cannot be the *work of* theſe *little Things*.

P. You

P. You are in the right, *Matho*, *nothing can act where it is not*; nor therefore can these Atoms act at thousands of Miles round them. The first Conference.

M. I think now I understand the Nature of Attraction better; only tell me, since all Bodies in the Earth mutually attract each other, why do we not observe this in any two Bodies; two Stones, for instance?

P. The Force whereby they tend to the Earth is incomparably greater than that Force whereby they tend to one another; wherefore the stronger Force overcomes the weaker, and renders it inobservable.

M. I see indeed it must be so.

P. And yet in some Circumstances, their attracting one another is perceptible.

M. Pray tell me in what Circumstances?

P. If you take a Vessel of Water, and put into it some small Bits of Cork, or other light Bodies, not at great Distances from each other, and so as not to disturb the Water in putting them in; you will see them attract each other, and meet: And if one Piece be considerably larger than the rest, by moving it gently with the Point of a Pin, you will see it draw the rest after it, wherever it goes.

M. This I shall try, as soon as I go to my Chamber. The Sight must be amusing, and seems to confirm what you have said.

P. It does: For though these little Bodies attract each other when lying at like Distances on the Ground, yet their Attraction cannot be then observed.

M. It

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M. It is not to be expected, since they have not any liquid Thing to swim in.

XII. *P.* I suppose you can now answer the Question I put to you before.

M. Pray put it again?

P. It was this, If all the Parts of this our Earth are endued with a Power of mutually attracting each other; in that Case, would there be need of any other *Support* or *Foundation*, on which the whole might rest?

M. I see plainly there would not; for the Weight of the Whole appears now nothing more, than the mutual Endeavour of all the Parts to come as near together as possible: Or, if I may express myself so, the Weight of the whole now disappears, or tends only to its own Center. So that regarding no external Thing from without, but only this mutual Embrace, or Contact from within, by that alone it remains firmly settled and immoveable.

P. You therefore see how this mighty Ball of the Earth may remain in the free Space, without tending to any Side; *poised by its own Weight*, as the Poet says; that is, poised by the internal Balance of its own Attraction.

M. I see, O *Philon!* and that with inexpressible Pleasure, this *mighty Ball* poised in the middle of the Heavens, with the Stars encompassing it on all Sides: For many of my childish Fancies are at once dispelled. The Sun is not plunged in the Ocean, nor pierces through a blind Mass of Earth; but travelling unweariedly

unweariedly round, illustrates successively the opposite Sides of the Globe, while the Shades and Dusk of Night fly before his Beams, and only cover the Regions which he hath left behind. The first Conference.

P. I easily guess, *Matho*, at what passes in your Mind: To come at a View of the true Constitution of Nature begets a *manly* and *rational Pleasure* in the Soul, quite different from the Pleasure you find in Diversions, or any other Thing.

M. O! they are not to be compared!

P. Likewise if the Sun illustrates successively the opposite Parts of the Globe ——

M. The enlightened Side moves always westward: He is but rising in the East to some, while he is already setting low in the West to others: And it is twelve a Clock to some Part or other of the Earth all the four and twenty Hours round. —— But while I consider in my own Mind this surprizing Nature of Attraction, and the Instance of the Load-Stone and Particle of Irons, I think I see something farther, which might be inferred from it.

P. Pray, what is that?

M. May we not conclude that, as all the Particles of this terrestrial Mass, endued with this mutual Tendency to each other, make the Earth one firm and stable Globe; so the Particles of any other less Body, the Load-Stone itself, or Iron, for Instance, having a like

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like Force or Tendency to one another, make that a ſolid and firm Body?

P. You carry your Views rightly enough, *Matho*, from the one Caſe to the other: Perſons of more Years and Experience are not always ſo happy.

M. There ſeems to be a Sort of Affinity between them, which directs one's Mind from the one to the other: For in both Caſes leſſer Parts, by attracting others mutually, make up a greater Body.

P. But what would you ſay, if it were objected that any Particle, how little ſoever, is made up ſtill of leſs Particles?

M. Provided *all* the Particles are endued with this Force of mutual Attraction, it is of ſmall Conſequence, I think, what Bulk they are ſuppoſed to be of: For he, who aſcribes Attraction to *all* the Parts, denies it of *none*.

P. You are in the Right; and there are ſtronger Reaſons to be given for this Inference of yours, than we can at preſent conveniently enter upon: Only in the mean Time I ſhall tell you, that the firſt of theſe Forces, whereby Bodies tend to the Center of the Earth, is called *Gravitation*; and the other, whereby the Parts of particular Bodies cleave ſo cloſely together, is called the *Attraction of Coheſion*.

M. I underſtand; for theſe Names are appoſite enough, and imply the different Effect in both Caſes.

P. But are both Sorts of Attraction, think you, equally ſtrong?

M. Let

The first Conference.

M. Let me consider your Question a little——certainly they are not; for I know I can easily raise a Pebble from the Ground; that is, I can easily get the better of its Gravitation: But the firm Cohesion of its Parts I can neither overcome by Strength nor Art.

P. But is this Cohesion of Parts equally strong in all Sorts of Bodies?

M. That is to ask, if *Glass* and *Iron*, or *Wax* and *Brass*, be equally firm Bodies.

P. To what Cause then would you ascribe this Cohesion of Parts?

M. Not to Matter itself surely.

P. Why so?

M. Because if Matter cannot do that which is less, or effect *Gravitation* in itself, it can much less do that which is greater, or produce in itself the stronger Effort of *Cohesion*.

P. It is certain, *Matho*, both Sorts of Attraction are effected in Matter by the same *immaterial Cause*, which I hope in Time you will discover; but there is still another remarkable Difference between them, which it is proper you should be acquainted with at present.

M. Pray is it possible for me to find it out myself, by your asking me Questions as you did before?

P. I believe it may; wherefore tell me, do the Particles in a Stone cohere more firmly the larger the Stone is?

M. I do not think they do.

P. Your Reason?

M. Because

The first Conference.

M. Becauſe I ſee a ſmall Stone or piece of Iron as hard as if it were ten or a hundred Times bigger.

P. Is then this Attraction of Coheſion mutual between all the Particles of ſuch Bodies, or only between the Particles that touch each other?

M. Only between the Particles that touch each other, I ſuppoſe; otherwiſe the Hardneſs of a Body would be increaſed with its Bulk. And now I fancy I perceive the *Difference* you intended to acquaint me with.

P. To wit?

M. Whereas the Attraction of Gravitation is mutual between all the Particles of Matter in the whole Earth, the Attraction of Coheſion is only between the contiguous Parts of Bodies.

P. That was the very Thing: And as in the former Caſe you juſtly admired the infinite Multiplicity of Action from any one Particle to every other Atom in the whole terreſtrial Globe; ſo— —

M. Pray hold, and let me conſider the Thing myſelf.— The Multiplicity of the Action in that Caſe is indeed aſtoniſhing and almoſt incomprehenſible: And in this of Coheſion it is, I think, equally wonderful, that the Action, though ſimple, ſhould yet be exceedingly more ſtrong.

P. There is ſurely an inconceivable Art diſcovered to us, in adjuſting theſe Forces, if we would but reflect: But this likewiſe is

wonder-

wonderful, *Matho*, that the one Sort of these Actions doth not interfere with, or disturb the other. The Particles of the Iron or Stone, that have an Action directed to every Atom in the whole Mass of Matter in the Earth, and therefore to the very Particles in Contact with them, have yet a stronger Action directed to those very contiguous Particles, whereby they adhere to each other with almost an insuperable Force. And these Actions, though in the same Direction, could not be preserved more distinct, if those small Atoms had been even large enough to allow Pulleys and Engines to be fixt to them, and each of these wrought by a skilful Hand. The first Conference.

M. I can hardly express how much you heighten my Admiration; and farther confirm to me, that such prodigious Force, and Distinction of Degrees, can never be the *Work* of these little Atoms.

P. And then consider what Inconveniencies would follow, if Bodies were hard in Proportion to their Bulk; which would certainly be the Case, if the latter Sort of Attraction were directed from every Particle to every Particle of Stone, Iron, *&c.*

M. Indeed then the Stone in the Quarry, or the Timber in the Tree would be impenetrable to human Industry: Or contrarily, if Bodies were soft and yielding, as they are small, Artists could not only not give their Work that curious Fineness, but there could be no working in *Stone*, *Wood*, or *Metal*, without In-

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ſtruments exceeding in Bulk thoſe Materials; which is as much as to ſay, there could be no working in them at all. A *fine Edge* or *ſharp Point* would ſignify nothing, having the Softneſs of Wax, or ſomething more yielding.

P. And yet the greateſt Part of Mankind little think of theſe Advantages which we ſolely owe to the *Cauſe* which effects this Difference of Attraction in the ſeveral Parts of Matter; as if we owed them to *Chance*, or *Neceſſity*, or *nothing*.

M. That Cauſe is the Thing I chiefly want to be informed of: But if you pleaſe, I would conſider by my ſelf, and at Leiſure, the ſeveral Particulars we have already talk'd of, before we go farther.

P. It is very proper you ſhould do ſo.

M. But I ſhall take my leave of you only on theſe Terms, that we reſume our Subject after ſome Days.

P. If I can be of any Uſe to you, you ſhall find me willing at all Times.

THE Second CONFERENCE.

The spherical Figure of the Earth demonstrated from other Arguments: Of the Usefulness and Necessity of Mountains: Of the Magnitude of the Earth and Moon: Of the Distances of the Moon and Sun from the Earth. The Absurdity of supposing the Heavens and whole Frame of Nature to whirl round in four and twenty Hours: That instead of this monstrous Conversion, the Earth only performs a Revolution on its own Axis in the same Time. The Order and periodical Revolutions of the Planets in the Solar System.

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XIII. *M.* I Return to you, *Philon*, a perfect Convert to your new Doctrine, and value my Happiness not a little in having got rid of some of my most childish Notions. Almost ever since I left you, I have been thinking of the wonderful Property of *Attraction*, and the spherical Figure of the Earth: But I have still a small Difficulty with respect to this last Point, which I must beg you to remove.

P. Well, *Matho!* What do you think of Attraction now?

M. I can hardly express my Admiration of it: Without Attraction no Body could be

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weighty, or have any Degree of Firmneſs and Solidity, nay, nor be fit, I think, for any one Purpoſe in Nature.

P. What do you think of Matter itſelf?

M. I have already told you, if it were not for this Attraction I do not know what it would be good for.

P. But when endued with the Principle of Attraction, what are your Thoughts of it?

M. It then becomes a *ſolid Subſtance*; it gives way, or quits its Place, if impelled by a ſufficient Force, and drives other Matter out of its Place, when that happens to lie in its Way.

P. By what *Power* does one Body thus drive another out of its Place?

M. By its *Solidity* I ſuppoſe, and not by any Power; ſince it is neceſſary that it ſhould be moved itſelf, before it can impel any other Body.

P. Could not *Body* change Place of itſelf?

M. If, as you affirm, it could not ſo much as *fall downward* without ſome *external Cauſe* (of the Truth of which I am already almoſt perſuaded) I do not think that Body, or Matter, of itſelf could at all change its Place: For *falling downward* ſeemed to me, of all other, the moſt natural Action of Body. But concerning this external Cauſe I have beat my Brains long and fruitleſsly to find out what it may be.

P. It pleaſes me, *Matho*, to ſee you thus ſolicitous to find out the Cauſes of Things; and I dare

I dare engage for it you have not beat your Brains in vain. But here I must acquaint you that this Want of Power in Matter is called its *inertia* by the Philosophers.

M. The Appellation seems proper and expressive; for according to my Notions Matter, considered in itself, is as *inert* and *sluggish* a Thing as can well be imagined.

P. Have you any Notion what Matter would be, if this Power of Attraction were not constantly exercised upon it?

M. Let me think a little, —— I do not know what other People may have, but I am sure I have no distinct Notion of it.

P. It is no wonder, *Matho*; no Man ever had, nor ever will have a distinct Notion of it, only so far as it is thus acted upon by an immaterial Cause: But possibly you may come to know more of this afterward.

M. In the mean Time then, let us, if you please, come to the small Difficulty that still remains with me concerning the spherical Figure of the Earth.

P. Let me hear what it is.

M. What are we to think of those high Mountains, which in many Places rise above the Surface of the Earth, and seem not well to agree with its spherical Figure?

P. Do you call whole Mountains, with all their Rocks and Precipices, only a small Difficulty?

M. You, who are to remove it, may give it what Name you please.

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P. Right.——Tell me then, have you ever obſerved the Surface of the Sea?

M. Very often.

P. It doth not riſe above the Level of the Shores?

M. It doth not certainly; otherwiſe the Sea would overflow the dry Land.

P. Doth it ſink far below the Land?

M. Not a great Way; for though in ſome Places the Coaſt riſes pretty high, yet in going on a few Miles you come to a ſmooth and eaſy Beach again.

P. Beſides, *Matho*, the Mouths of all Rivers are on the ſame Level with the Sea into which they empty themſelves: Whence we ſee the *Tide* flows up for a conſiderable Way within the Land in moſt of them.

M. It is ſo indeed.

P. The Shores then, if you except theſe ſmall *Riſings* and *Inequalities*, follow always the Figure of the Sea which they bound.

M. I own they do.

P. But what Figure do you think the *terraqueous Globe* would have, if it were all Water; the Particles of that Element being endued, as they are, with the Power of mutual Attraction, which we ſpoke of before?

M. Give me Time to conſider what Effect Attraction would have in this Caſe?

XIV. *P.* As ſuch a huge Maſs of Water may perhaps perplex your Thoughts, take at firſt only one ſingle Drop; you will manage that

that more easily in your Imagination: And whatever agrees to it will agree to any Quantity of Water, how large soever.

M. A Drop of Water just ready to fall is, as I have often observed, almost spherical.

P. However, let us imagine that the Figure of this Drop may be at first somewhat long, of the Shape of an Egg; and then are there not more Particles of Water in the Length than in the Breadth of the Drop?

M. Certainly.

P. Is there not therefore a stronger Attraction according to the Length of it, than in the Breadth?

M. Without Doubt, because there are more Particles that attract that Way.

P. Must not the Water, being fluid, yield to the stronger Attraction, and so the Drop become shorter?

M. This is still plain.

P. Could the Drop therefore remain in any settled Figure, unless all the Sides of it were equally attracted?

M. It could not.

P. That is, unless all the Particles were at an equal Distance from the Center of the Drop, and so it became spherical?

M. In one Drop the Reason is plain: We cannot imagine that it could have any *Corners* or *Angles*, or what could keep the Particles at a greater Distance in *those*, than in other Parts.

P. But is not the same Reason conclusive, to whatever Bulk we imagine the Drop to grow?

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M. I cannot admit that ſo eaſily; for we obſerve they are but ſmall Drops which thus become round.

P. What is the Reaſon we do not ſee any Quantity of Water ſettle in a ſpherical Figure?

M. I ſuppoſe the Attraction is not ſtrong enough to bring all the Parts into ſuch a Figure.

P. That is not the Thing, *Matho*; but in larger Quantities their Weight toward the Earth ſoon diſturbs and overcomes the Attraction between their Particles, which hinders a globular Figure to take place in them.

M. I perceive it muſt be ſo; or the Attraction of Gravitation is ſtronger than the Attraction of Coheſion in this Caſe.

P. Imagine then in your Mind the Earth to be quite removed, and that there is but one Drop of Water in its Place: You will allow this Drop muſt be round?

M. I have allowed that already.

P. Suppoſe then it grows ſtill larger and larger to any Bulk you can conceive; being no where attracted from without, and having only this Attraction between its own Parts from within; what Figure do you think the whole Maſs would put on? Remember *Gravity in this Caſe diſappears*, or as you yourſelf ſaid, *tends only to the Center of the whole Maſs.*

M. You have diſcovered to me the Miſtake I laboured under. I ſee in theſe Circumſtances, let the Drop grow as big as the whole Earth, or as twenty Earths put together, the Reaſons you

you have given for the Roundness of one Drop will be applicable to the whole Bulk. Having no Tendency to any Side from without, and the Parts endeavouring to approach as near to the Center as possible from within, a fluid Mass will always settle in a spherical Figure.

P. For if it had any *Corners* or *Angles*, any *Protuberances* or *Heights*, what could keep the Water in these Parts at a greater Distance than in others?

M. Go on, *Philon*; I own there could be no Promontories or Mountains in such a Bulk of Water, more than Corners or Angles in a single Drop.

P. From this mutual Attraction of Parts therefore, what Figure do you suppose this terraqueous Bulk would put on, if it were all Water?

M. A spherical Figure without all Doubt. ——But pray let me interrupt you to ask why the *Soap-Bubbles*, which Boys have such a Pleasure in blowing up, that they may behold the strange Variety of fine Colours in them, are all of this spherical Figure, whether they be great or small?

P. These Bubbles, *Matho*, are not the Diversion of Boys only, but also of Philosophers; and this their spherical Figure is owing to a different Cause.

M. To what different Cause?

P. It is owing to the *mutual Repulse* between the *Particles of Air*: For this contrary Affection serves great Purposes in Nature, and proceeds

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ceeds from the Power of *the ſame immaterial Cauſe.*

M. Tell me but one of *theſe Purpoſes* which a mutual Repulſe of Parts ſerves for, that I may think of it by my ſelf.

P. Could you breathe, do you think, ſuch a cloſe and thick Subſtance as Water?

M. If that were poſſible, no Body would ever be drowned.

P. But if the Particles of Air, inſtead of repelling, attracted each other, they would make a Subſtance as denſe as Water.

M. How do you know that?

P. Becauſe Water, when exhaled by the Heat of the Sun, or otherwiſe, dilates itſelf into a fluid as light and thin as Air.

M. It is ſo indeed; for I ſee the Steams and Vapours riſe up in all ſuch Caſes—— Well! It ſeems we owe our Lives, not only to the Attraction, but to the mutual Repulſe between the Particles of Matter! This is ſurprizing! ——Pray tell me now *what Cauſe* it is that produces theſe wonderful Effects?

P. Suſpend a little, I beſeech you, your Enquiry into the *Cauſe*, till you are better acquainted with the Effects: That is the beſt Way to become rightly acquainted with the Nature of the *Cauſe.*

M. Be it ſo: I am certain your Advice muſt be good, therefore I ſhall endeavour to maſter my Impatience.

P. To return; you are ſatisfied that a Maſs of Water as large as the Earth could ſettle in no other than a ſpherical Figure? *M.* I

M. I am; for the Parts of a Fluid must easily yield to the Force of Attraction, and not rest till the Attraction can bring them no nearer each other. The second Conference.

XV. *P.* Now if the Sea can only settle in a spherical Figure, and if the Earth follows the Figure of the Sea, what are we to conclude from thence? ——

M. There is something here that seems to stick with me still. If indeed the whole Mass were Water, the Point would admit of no Dispute: But the Earth may be of a very irregular Figure, and covered by the Sea only to a small Depth; in which Case the Sea should rather seem to follow the Figure of the Earth.

P. Think better on the Point, *Matho:* The Inequality of the Bottom doth not at all affect the Surface of any Liquid, or make that uneven or irregular, which you may be satisfied of from the most common Instances. The Bottom of a Pool may be rugged and uneven, but the Water on the Top is always smooth.

M. Pardon my Inattention; I did not reflect that the Reason is the same in large as in small Quantities of any Fluid: But now I perceive, if the Sea were so deep as to cover the Tops of the highest Hills, the Heights under Water could make no *Swellings* on the Surface; and then this universal Ocean would be truly spherical.

P. For you remember *there could be no Promontories or Mountains of Water.*

M. If I do not, I find you do: But I deserve to be thus twitted. *P.* If

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P. If then the Sea quite ſurrounds the whole Earth, which our Navigation in this Age leaves no Room to doubt of, (though perhaps the Coaſts and Shores may not go on in a ſtrait Line, but wind out and in irregularly enough,) the whole Surface of this continued Ocean cannot be other than ſpherical; and therefore the whole terraqueous Maſs muſt be of a ſpherical Figure, ſince the higheſt Parts of the dry Land are raiſed above the Surface of the Sea, but to a ſmall Height, if compared with the vaſt Bulk of the whole Earth.

M. I perceive at laſt the ſeveral Parts of your Argument meeting together, and concluding the Thing to the Sight of the Eyes.

P. If we ſhould ſuppoſe the Sea only four or five Miles higher than it is, it would cover the Tops of the higheſt Hills (as you were ſaying:) And if we imagine it to ſink down again to the preſent Limits, we ſhould indeed ſee, as it were with our Eyes, the preſent Figure of the whole terraqueous Globe to be next to ſpherical: For four or five Miles are but a ſmall Matter in reſpect of ſeveral Thouſands.

M. And from this ——

P. Go on.

M. From hence I think it will follow that the Surface of any Pool, or ſtagnant Water is a Portion of the ſpherical Surface of the Ocean.

P. It is perfectly well obſerved, *Matho*; for Water, in what Quantity ſoever, always ſettles on the Surface to the Equality of Attraction, as if there were no ſolid Ground near it: And if there

there were not, it would really become a Part of the spherical Surface of the Sea, raised to that Height, though to the Sight of the Eye it appears plain. The second Conference.

M. I conceive it fully: Any small Part of the Surface of the Sea, a Mile round for Instance, appears to the Sight a level Plain.

XVI. *P.* Now to return to the Subject with which we began, *The Heights and Inequalities of the Hills*, to wit; if the terraqueous Globe were accurately spherical, would it have the same Advantages it has at present?

M. I am at a Loss to know in what respect; make your Question, if you please, more particular.

P. If the Earth were perfectly spherical, how could the Water of the Ocean dispose itself?

M. O! I have it. The Water of the Sea would then cover the whole Face of the Earth to some Height or other; or it would then be equally spread over the Surface of such an accurately spherical Globe: And there being no dry Land, our Globe could only be in that Case a Habitation for *Fishes* and *Sea-Monsters*, I perceive unspeakable Advantages on the Side of the present Figure of the Earth.

P. But if the Surface of the Sea were sunk a Mile or two below the Land, and the rest of the Globe of a perfect spherical Figure, only thus much higher, would that Disposition of Things have any Convenience or Inconvenience above the present?

M. From

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M. From the former Caſe I foreſee what would happen in this. If there were any Water at all on this higher Part of the Globe, it muſt cover it all equally: If there were none, the dry Part of the Earth muſt then be *dry* indeed, without Rivers or running Waters, to the great Inconvenience of *Man* and *Beaſt*.

P. It is ſo; for that the Earth may be fruitful, and produce Herb for the Uſe of Man and Beaſt, it muſt abound with Springs and running Waters: Nor could there have been a *Deſcent* for *Rills*, *Brooks*, and *Rivers*, unleſs from ſuch Heights and Inequalities as we ſee at preſent; which, being ſo moderate, neither deform (nor hinder the Deſign of) the ſpherical Figure of the Earth, and yet make the dry Land a comfortable Habitation for Man, and all Creatures that have the Breath of Life.

M. I ſee now the ſurprizing *Art* and *Contrivance* of Nature! the Uſe and Beauty of thoſe Inequalities, which before I looked upon only as a *mere Negligence*!

P. And hence it is that Mountains are ſupported with firm and unyielding Rocks, as it were with Bones, that they may ſtill preſerve their *Heights*, which are ſo neceſſary. *Soft* and *yielding* Mountains of *Clay*, or *pure Mold*, muſt, by ſinking down, have in time filled all Places with dead Waters, or ſtinking Puddles.

M. How raſh *are thoſe Men*, who fancy that the Mountains are only *Blemiſhes* of Nature, and good for nothing!

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P. The Man who criticises on the Works of Nature, *Matho*, challenges pretty plainly to himself a Superiority of Knowledge over the *Author* of *Nature:* A Folly which a sober Person will hardly be guilty of. Mountains to the Eye may seem rough and disagreeable; but whosoever will reflect on their internal Structure must own it is a Piece of Work designed by Art, no less than the Body of an Animal. For the internal Parts must be *firm* and yet *open*, or at least not close and dense Matter, that they may admit into their Cavities the Rains and Water falling from the Sky: Nor must the *Cœlestial Store* stagnate there, but perform a various and mazy Course, till it breaks out again into the open Air, at the Sides and Roots of the Hills: Whence it flows in winding Streams to enliven the parched Soil, and chear the thirsty Tribes of Animals.

M. Methinks I see all this various Contrivance wrought in the dark Bowels of the Mountains.

P. In this Case, *Matho*, we seem not to have a Taste for *great Beauties*, but for little affected Niceties. It is as absurd to expect that the Mountains wrought by Nature's Hand should have the smooth, pitiful Figure of a *Garden-Mount*, as to fancy that a Ship's Anchor must be wrought with the Finery of a Trinket in a Toy-Shop.

M. You have certainly, *Philon*, given me a just Taste of the beautiful Variety of *Plains*, *Hills*, and *Vallies*; of which I remember the *Poet* says, *Jussit*

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Juſſit et extendi campos, ſubſidere valles,
Fronde tegi ſylvas, lapidoſos ſurgere montes.

It is Ignorance or Inattention only which make Men imagine, that the Earth would be either more beautiful, or more convenient, if there were no Hills.

P. The Views of Men are too narrow, *Matho*, when they would paſs a Judgment on the great Works of Nature. For the Weight of the large Tracts of Mountains in the ſeveral Parts of the Earth muſt exactly balance one another, for a Reaſon which poſſibly you may diſcover afterwards: And their Height and Bigneſs muſt anſwer to the ſpacious Plains they are to water below.

XVII. *M.* Since now I preſume I am pretty well ſatisfied about the Figure of the Earth; pray what are we to think concerning the Figures of the other remarkable Bodies of the Univerſe: The Sun, Moon, and Stars, I mean?

P. What do you imagine of their Figure from the Appearance they make to the Eye?

M. If I conſider their Appearance, the Sun and Moon ſeem rather to be *flat* and *circular*, than *ſolidly globular*.

P. If you were to ſee a Wooden Globe ſuſpended at a conſiderable Diſtance, how would it appear; flat and plain, or convex and ſpherical?

M. If

M. If it be too far removed, the Convexity of it disappears, and it seems only plain and circular, like a Trencher.

P. It is so; the Greatness of the Distance makes the Convexity imperceptible, and a spherical Body appears only like a plain circular Surface. Now since a spherical Body makes this Appearance at a great Distance, what Figure would the Earth appear of to a Spectator removed from it to the Distance of the Moon or Sun?

M. For the same Reason it must appear plain and circular.

P. It certainly must; for the Shadow of it, when *that* falls upon the Moon, is always circular; and the Earth itself could have no other Appearance at that Distance than of a flat circular Body.

M. Explain a little, if you please, how the Shadow of the Earth falls upon the Moon; because, if left to myself I shall fall into some wrong Notion about it.

P. There is no Mystery in that Affair at all, if this were the proper Place to speak of it: However, I shall tell you thus much by the Way: The Earth casts always a Shadow on that Side which is turned from the Sun, just as a Ball does upon the opposite Wall, if a Candle shines on the other Side of it.

M. So far I understand; for it is this Shadow cast by the Earth, when the Sun is on the opposite Side, that makes it Night; when the

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Stars appear, and the Moon ſhines with all her Splendor.

P. You will likewiſe obſerve, if we come to ſpeak of the Syſtem of the Planets, that the Moon, when *full*, is directly on the oppoſite Side of the Earth to the Sun.

M. I have indeed obſerved it ſo: For the *new Moon* is never far from the Sun, but always removes to a greater Diſtance from him, as ſhe draws nearer the *full*.

P. It happens ſometimes then, that ſhe muſt enter into, and paſs through the Shadow of the Earth, when ſhe is ſaid to be *eclipſed*.

M. I have heard of the Moon's being eclipſed, and ſeem now to underſtand the Cauſe of it.

P. In the *Eclipſe*, as the Moon enters into the Shadow of the Earth, it looks as if a black Circle were coming over her: For her Surface appearing plain, the Part of her obſcured is always circular.

M. This is not difficult to be conceived: I could repreſent the Moon by a Circle of white Paper, and the *Shadow* by a large Circle of black Paper gradually intercepting the View of it.

P. You might: And from this Appearance we may again conclude with Certainty, that the Figure of the Earth is ſpherical.

M. Pray ſhew me how you draw that Concluſion?

P. You will ſee it thus. Since the Shadow of the Earth, which the Moon paſſes through, falls ſometimes from one Side of the Earth, and

and sometimes from another, and yet still appears circular on the Moon's Surface, either as she enters into it, or comes out of it; it is plain the Body which casts this Shadow must be spherical. For if in any Position of a Body, the Shadow it casts upon an opposite plain Surface, be still circular, that Body must be *every Way round*, or spherical.

M. This I easily conceive from having often diverted myself with the Shadows of Things on the Wall: For if the Shadow of a Ball and of a flat circular Body, like a Piece of Money, fall upon a plain Part, the Shadow of the Ball is always round; but if you turn the *Edge* of the circular Body to the Light, the Shadow becomes a straight Line. But how does the Shadow of the Earth fall sometimes from one Side of it, and sometimes from another?

P. You may remember you said before, that it is twelve a Clock to some Part or other of the Earth, all the four and twenty Hours round.

M. I did; and that when it is Mid-Day to us, the Sun is but rising to some that are West of us, and already setting to others that are East of us.

P. The Sun therefore is always rising and always setting to different Parts of the Earth all the twenty four Hours round?

M. It is so.

P. The enlightened half of the Earth then, always veering about westward, the Shadow must be cast by different Parts of the Earth's

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Surface. You find it is so in the Example you mentioned just now; for whether you turn the Ball round before the Candle, or carry the Candle round the Ball; different Parts of the Ball will be enlightened, and therefore the Shadow formed by different Parts of its Surface.

M. The Matter appears to me now extremely plain. Only tell me why the Shadow of the Earth doth not eclipse the Stars as well as the Moon.

P. It ends in a Point, before it can reach any of the other heavenly Bodies.

M. Pray, how is that?

P. You will lead us from our Purpose, *Matho*; however, as you have sometimes diverted yourself with projecting Shadows on the Wall, you will easily apprehend the Case.

M. I am glad of having diverted myself so, if that will help me to understand these Things.

P. If the Body, whose Shadow is projected, be bigger than the *luminous Body*, the Shadow grows always larger, the farther it goes.

M. That I know; having seen my own Shadow of a gigantick Size.

P. If the Sun then were less than the Earth, its Shadow would still grow larger, and reach out to an infinite length: But if, on the contrary, the Sun be larger than the Earth, its Shadow must grow always less, and at last end in a Point.

M. So then it seems the Sun is larger than our Earth? I am glad to have discovered that

so

so easily, and shall not trouble you farther with my Questions on this Head. The second Conference.

XVIII. *P.* To return then to the Figure of the other cœlestial Bodies; supposing the Sun and Moon are vast spherical Bodies, like our Earth, (and you have seen already the Sun is bigger) and that they are placed at a great Distance from us; what sort of a Figure, think you, must they appear to have, when seen from hence?

M. They must, by what you have shewn me before, appear *flat* and *round*, not *spherical*.

P. And since they actually appear flat and round, what Figures must the Bodies themselves really have?

M. A spherical Figure, I suppose: And besides it seems some way or other unnatural to imagine them *flat* and *thin* Bodies.

P. That Fancy would be whimsical enough: But what you say is confirmed from this Consideration, that some of the cœlestial Bodies (and among these the *Sun himself*) are constantly turning round on their Axis, (as it is called) and so shew successively all their different Sides to us; and since in every Position they appear round, their Figure cannot be other than spherical.

M. That Circumstance, indeed, puts the Thing out of Doubt: For if the Sun were a flat thin Body, upon turning his edge to us, he would appear (like the circular Body we just now spoke of) a *long bright Line*; which

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would be an odd sort of a Figure for the Sun. But leaving the Sun and Moon, of what Figure are the other cœleſtial Bodies?

P. Some of theſe too, I have told you, are diſcovered to turn round on their own Axis, and ſtill appear circular.

M. Theſe therefore are *large Globes*, I ſuppoſe.

P. They certainly are.

M. What is the Reaſon then, that none of them appear ſo large as the Sun and Moon?

P. You know, *Matho, a Houſe at ſix or ſeven Miles diſtance could hardly be ſeen; or, at beſt appear very ſmall.*

M. Good: However, I know now that the Sun is larger than a Houſe.

P. But tell me, if the Sun were ſtill removed to a greater Diſtance from us, or (which comes to the ſame Thing) we carried to a greater Diſtance from him; how would he appear from this Change of Diſtance?

M. He would ſtill appear leſs and leſs.

P. And if he were thus removed *without end*, what would follow?

M. He would, in Time, appear only like one of the biggeſt Stars, and afterward like one of the ſmaller: And certainly, if he removed *without end*, we ſhould at laſt loſe Sight of him altogether.

P. It is ſo; ſmall Bodies, by increaſing their Diſtance, ſoon diſappear; and the largeſt muſt do ſo too at laſt.

M. But

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M. But I think I have observed a Difference in this Case, between *shining* and *dark* Bodies: *A Candle* is seen at a great Distance in the Night-time, while a larger Body, though in the strongest Sun-shine, cannot be seen near so far by Day.

P. Your Observation is extremely just: Bodies that are seen by their own Light pierce far, while Bodies that are discerned only by the Light of another, strike the Eye less forcibly. And it is quite inconceivable, at what immense Distances some of the *shining Bodies* in the Sky are placed from us. Which Things it may hereafter be of great Use to you to remember.

M. When there is Occasion, I shall easily call them to Mind.

P. As to the other Part of your Observation, it is a very necessary Condition of seeing a *lucid Body* at the greatest Distance, that no Light strike the Eye but it's own. All the Stars, you see, disappear by Day; and the lesser are not easily seen when the Moon shines bright. And if there were an intense Darkness, Stars that now escape the quickest Eye would be discerned.

M. In looking up to the Heavens in a starry Evening, *Philon*, I have often admired with myself, the Immensity of *that Space*, and fatigued my Imagination, to find out if it had any Limits; and what you said just now of the Sun's being *removed without End* brings it to my Mind again: Pray could a Body *move on endlessly?*

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P. Why not? as well as *the Earth be ſtretched out endleſsly in Breadth?*

M. That was only an inconſiſtent Notion of mine: But could a Body move ſtraight forward for ever, without finding any Thing to ſtop it?

P. Nothing could ſtop it, unleſs it were another Body.

M. And could it move on thus to any Side?

P. To any Side, to which you can ſuppoſe it to move at all.

M. This is extremely ſurpriſing! Pray is there nothing in all this *infinite Room* or *Space?*

P. If there be nothing in it, then *nothing* would be infinite, while *ſomething* is but finite.

M. You ſpeak too conciſely; pray direct me how to think in this Caſe.

P. It is too ſoon for you to enter on this Speculation.

M. Remember your own Words, *Philon.* ——*The plain and ſimple Truth is to be laid open to young Perſons, as ſoon as they begin to turn their Thoughts to any Subject.*——

P. You puſh me unaccountably, *Matho!* However, as you have ſtarted that Thought, which naturally leads young Minds to their firſt Notion of Infinite; all that is neceſſary for you to know at this Age is, that ſome *poſitive Thing, ſome Being*, muſt be infinite: For that *Emptineſs*, or *Void*, or *pure Nothing*, ſhould be infinite, is both abſurd and impious.

M. But may not *Matter* be infinite?

P. What is Matter abſtracted from the Principle of Attraction we ſpoke of before?

M. I

The second Conference.

M. I owned to you then, *I had no distinct Notion of it, without that Principle:* All that remains, abstracting from that, is some *sluggish dead Thing.*

P. How would it sound, to say *infinite Deadness, infinite Inactivity?*

M. As ill, I think, as *infinite Emptiness, infinite Nothing.*

P. If then Matter, informed by this Principle, were infinite, that would necessarily suggest to us *a prior*, and *nobler Infinite* than Matter; since you have already perceived, from some good Reasons, that Attraction is the Power of an *immaterial Cause.* And though any Man could have a Notion of Matter without *that Principle*, whereby it can only become a solid Substance, *such a Thing* infinite could only be *infinite Inactivity*, *infinite Want of Power.* But for other Reasons Matter cannot be infinite. And at any Rate to suppose it such, is either supposing a Contradiction, or allowing a prior and nobler Infinite.

M. I have even some Notion of this, so far as it depends on what you shewed me before; and I'm sure it is better to have heard it, than to be left to the Uncertainty of my own Thoughts. But since some *positive Being* must be infinite, may we not enquire into the Nature of that *nobler*, *prior* Infinite?

P. O! by all Means; let it be the Business of your Life: But if you have a Notion how absurd *infinite Deadness*, *infinite Inactivity* is, endeavour to get a Notion of *Infinity of Power*, *Infi-*

The second Conference.

Infinity of Life, Infinity of Knowledge: For what is infinite must be infinite in Perfection, *in all Perfection.*

M. I perceive, if I should say *infinite Deadness*, or *infinite Weakness*, that would render *Life* or *Power* impossible; because there could be no Room for the *Perfection*, if the *Imperfection* were infinite.

P. Cherish this Notion, *Matho*; Infinity itself is the greatest Perfection, and most People are not aware of the Absurdity of joining it to mere Negations. I have now nothing left to add on the Subject.

XIX. *M.* Will you give me Leave then to propose a Thought to you concerning the Subject we were upon before?

P. I shall listen to it with great Pleasure.

M. When I consider this spherical Figure of the cœlestial Bodies, and how unnatural it is that any of them should have been *thin* and *flat*; and when I reflect on that Attraction which obtains through the whole Bulk of the Earth, which naturally produces a Roundness of Figure in any Mass of Matter; I begin to think that this Property of Attraction is no less prevalent in the *Bodies above*, than in our Globe.

P. The Thoughts are very naturally joined together, *Matho*; and no less solid than ingenious: For do you still remember your own Observation?

M. What?

P. That without this Attraction no Body could have

have been weighty, or have had any Degree of Firmness and Solidity; nay, nor have been fit for any one Purpose in Nature? The second Conference.

M. I do.

P. And you still allow *that this Attraction is not the Work of Matter itself?*

M. That I am more and more persuaded of: For how could a Particle act at a Distance? Nothing can act but where it is. Or how could it act ten thousand different Ways at once?

P. Matter could not then be *solid Substance*, or adhere one Particle of it to another, without Attraction?

M. It could not.

P. We must allow Attraction therefore in *those Bodies*, as they are solid Substance, abstracting from their Figure?

M. I see it plainly; we must. And not only there, but every where else. This Consideration makes the Attraction of Cohesion universal.

P. And then as to Gravitation; the Particles of Matter in those Bodies could not have fallen into this spherical Figure of themselves; since *Motion*, *Change of Place*, and *falling downward* (that is towards a Center) all proceed from this Attraction.

M. All this is still fresh in my Mind, and I discover now the Truth of that which I thought at first was only a probable Conjecture. Without Attraction the Particles could never have come into this spherical Figure; unless we should suppose that some *unknown Being* had at first laid them all in this round Form.

P. That

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P. That must have been a painful and tedious Task, *Matho*; but even this extravagant Supposition is insufficient, since the least Force might have disordered them again: For Attraction is as necessary to preserve a spherical Figure, as to form it at first.

M. I have some Conception of what you say; but explain it to me a little, if you please.

P. Body could not have Weight if it were not attracted.

M. Surely not, since Weight is only the Force of this Attraction acting constantly.

P. Water could not tend to the lower Ground if it had no Weight, nor change the Figure it should at any Time be put into.

M. That is undeniable.

P. You might build Water then, or rather lay it in the Form of a *Wall*, a *House*, a *Pyramid*, any Thing you please to imagine; it could not move from the Place in which you laid it.

M. The Thought is surprizing; and yet there is no denying the Consequence! I see Water could not be Water without this Attraction: I could mould it into any Figure: Nay, I could lay a Quantity of it as high as I could reach over my Head, and it would remain there. This is all Wonder! What should we drink! I thought Water had been necessarily Water.

P. All the Water in the Sea therefore, or all the Matter in the Earth, might be laid in the Form of a flat thin Body, or disposed of in a huge Length, or in many other Ways

we

we might conceive; and it could never more return to a spherical Figure again.

M. You satisfy me abundantly, O *Philon!* that Attraction is as necessary to preserve a spherical Figure in the great Bodies of the Universe, as to bring them into it at first. I am overjoyed to find this Attraction as universal as it is wonderful. It is salutary to us so many Ways; and a Kind of Preservative, I think, to the whole Frame of Nature.

P. You will I hope have greater Reason to say so hereafter.

XX. *M.* Now since the Earth is bounded every Way, and of a spherical Figure, is it known how large the Globe of the Earth is?

P. This is known pretty exactly; but if you would be informed of any Thing about it's Magnitude, you must first understand the Names and Positions of some Circles, that are imagined to be on it's Surface, and are painted on this artificial Globe; because it is by the Help of these they have measured the Earth.

M. Pray make me acquainted with them. I have often admired these Lines, without knowing any thing of their Use.

P. These two Points are called the *Poles* of the Earth; this here raised above the wooden Frame is called the *Arctick*, or *North Pole*; it points to the Pole of the Heaven seen by us. The other sunk below is called the *Antarctick*, or *South Pole*; it points to the opposite Part of the Heavens, which we in this Part of the Earth never see.

M. You

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M. You named these Poles before, I remember, and spoke of the *Pole Star*: But why are they called *Poles?*

P. Because they are as it were the *Hinges* on which the Earth, according to some, or the Heavens, according to others, turn round in twenty four Hours.

M. This *English* Name suggests to me their Use, because any Thing may be turn'd on it's Hinges.

P. You will observe then that the Poles themselves do not turn round.

M. So I perceive by turning round the Globe.

P. The Line which joins the two Poles is called the *Axis* of the Earth.

M. I know very well what an Axis means, and what the Use of it is.

P. This Circle equally distant from both Poles is called the *Æquator*.

M. The Reason of it's Name is obvious.

P. All these Circles which you see cut the Æquator, and meet at the Poles, are called *Meridians*.

M. Why are they called Meridians?

P. The Word you know signifies something belonging to the *Mid-Day*. Now when the Sun comes to *our Meridian*, for Instance, he makes it Mid-Day, or Noon, to us; being equally distant from East and West.

M. I conceive it; and when he goes farther West he makes it twelve a Clock to another Place, and so on quite round: And since, as we have said before, it must be twelve a Clock

Clock to all Places round the Globe in four and twenty Hours, there are many Meridians; for every Place must have it's own Meridian, which has twelve a Clock at a different Time. The second Conference.

P. This Readiness of yours, *Matho*, saves me a great many Words, which I should be forced to use with some of your Age.—— We may consider the other Circles on the Globe hereafter, if there be Occasion: But you must know that every Circle is divided into three hundred and sixty equal Parts, which are called *Degrees*.

M. I observe indeed the Æquator on this larger Globe so divided, as also the great brazen Circle divided into 4 Nineties.

P. You must likewise know that the Point of the Heavens just over the Pole of the Earth doth not seem to move.

M. Because, I suppose, the whole Heavens seem to turn round on that Point.

P. And therefore they seem to turn round the *Pole-Star*, though a little distant from it. And this you may easily observe yourself in the Heavens any Evening: For you will see all the Stars change Place with respect to you, except the *Pole-Star*, which still keeps at the same Height above you.

M. I have observed the rest to move westward; but know not the Pole-Star, which I beg you would shew me some Evening.

P. I will whenever you please. Lastly, you may observe almost the same Circles on this other Globe, which is called the *Celestial*: For

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For they suppose the *Convex* Surface of the Earth, and the *Concave* Surface of the Heaven to be divided nearly the same Way.

XXI. Now, *Matho*, if any Person should go round the Earth on one of these Meridians; that is, if he should go over the whole three hundred and sixty Degrees of this Circle, must he not discover the whole Concavity of the Heaven *by Degrees?*

M. He must, by going round the whole Earth from *South* to *North.*

P. That is, would he not discover all the 360 Degrees of the *cœlestial Meridian*, which is over the *terrestrial*, one Degree after another?

M. He certainly would. This is easily conceived from what you said before, when you shewed me that the Earth was spherical from South to North, as well as from East to West: For if a Man should go one Degree forward to the North on the terrestrial Meridian, one Degree of the cœlestial Meridian must seem to rise above the Earth before his Eyes; and a Degree of it likewise must seem to fall below the Earth behind him; and so on; a new Degree would seem to rise before, and another to set behind him, through all the three hundred and sixty Degrees. This is the same Case with the *Ant* and the *wooden Bowl.*

P. You make the Application justly enough. But from the different Elevation of the *Pole*, or of some other Star, Mathematicians know very

very well when they have gone over a Degree of the terrestrial Meridian, or one three hundred and sixtieth Part of the whole Circuit of the Earth. And different Persons have carefully measured, both here in *England* and in *France*, how much this three hundred and sixtieth Part of the Earth's Circuit comes to, their several Calculations agreeing to a very Trifle. Thus, the Figure of it being spherical, they have discovered how much the whole Circuit of it is, and given in common Measure the greatest Thickness of it, or the Length of a Line from the one Side to the other, which is called the *Diameter* of the Earth. The second Conference.

M. Pray how long may this Diameter be?

P. It is little less than eight thousand Miles.

M. So far, therefore, are we distant from the Antipodes.

P. We are.

M. This is a prodigious Mass to be suspended in the *empty Æther!*

P. Does it yet seem wonderful to you, that the Earth should be suspended in the empty Æther?

M. No; you have corrected my Notions concerning that; but I fall inadvertently into the common Ways of speaking. The mutual Attraction of the Parts makes the whole Weight of the Globe tend inwardly to its own Center: So that it is of no Consequence, whether the Body be small or great, provided this Attraction be directed to nothing from without.

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P. To be ſuſpended therefore is an improper Expreſſion, and ſerves only to miſlead our Thoughts, as if *Body* tended naturally, and of itſelf, to one Side more than to another. It is more juſt to ſay, *Bodies are placed* in the ambient Space, than that they are *ſuſpended* in it.

M. You told me before, I remember, *That toward the Earth was downward, and toward the Heaven upward, on whatever Part of this Globe we ſtand.*

P. I did.

M. And that *the Center of the Earth was the loweſt Point of all, with reſpect to us.*

P. It is ſo.

M. I perceive from what we have ſaid juſt now then, that it muſt be ſo on any other great Body of the Univerſe. Towards its Center is always *downward*, and its Center muſt be the *loweſt Point*, with reſpect to the Weight of any Body placed on it.

P. There is all the Parity of Reaſon for this, there can be for any Thing.

M. This diſcovers to me the Foundation of my firſt Prejudice: For I thought there was an *univerſal downward* (if I may ſay ſo) with reſpect to the whole Infinity of Space, and an *univerſal upward*, that were unchangeable: Or that all Bodies naturally tended one Way. Whereas I now find that *downward* and *upward* change, both with reſpect to the oppoſite Sides of the ſame great Body, and with reſpect to the different great Bodies of the Univerſe.

P. You

P. You are right. *Downward* is only a relative Term with respect to the Center of any of those great Bodies: For when a Ship sails round the Earth, it would be ridiculous to think that your *universal downward* turned upward, that is, the contrary Way, when she came to the opposite Side of the Globe; or that *downward* and *upward* rolled round the whole Earth, and the whole Heavens too, as the Ship advanced on in her Course. The second Conference.

M. That would be a monstrous Fancy indeed.

P. That you may perceive the Absurdity of it more clearly, let us, if you please, suppose, that there was a Time when there was no Body at all in the infinite Space; and then try if you can imagine a *downward* or an *upward* in these Circumstances.

M. I find I cannot.——*down*,—— towards what? Or *up*,——towards what? No; *down* and *up* are vanished now.

P. *Down* and *up* are not absolute then?

M. Most certainly they are not.

P. Suppose again that only *one Body* existed in Nature, as the Earth, or the Sun; will *upward* and *downward* begin to appear in that Case?

M. Not an *universal downward* and *upward* more than before: There will only be a *downward* with respect to the Center of this Body, and *upward* from it.

P. Imagine there were two such Bodies in the immense Space: Will these give Rise to *absolute downward* and *upward*?

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M. No, though we ſhould ſuppoſe ever ſo many. *Theſe* are nothing in themſelves, only mere external Denominations.

P. It is ſo; they are nothing real; and it is ſtrange that the Generality of Men ſhould give them a Reality in their own Notions. If they were *real*, they would occupy or belong to the whole Immenſity of Space, and be antecedent to the Exiſtence of Matter. Hence then tell me, Do Bodies tend naturally and of themſelves to any one Side more than another?

M. They do not: Here was the Prejudice I laboured under, I now ſee to the Bottom of it.

P. Can *Gravity* therefore, or *Weight*, or *tending to any Place*, or *Motion of any Kind*, belong to the Nature of Body or Matter?

M. I perceive, dear *Philon*, from this familiar and convincing Argument they cannot; and that all theſe *(Motion, Weight, Tendency)* are the immediate Impreſſions of that IMMATERIAL CAUSE, with which you have not yet been pleaſed to acquaint me. But it gives me great Satisfaction to have come at this different View of ſuch an agreeable Truth. And if this remains a general Prejudice even among Men, how eaſy were it to throw the childiſh Notion of an *abſolute downward* and *upward* out of their Minds? It likewiſe gives me Pleaſure to think how acceptable the Diſcovery of this Truth will be to my Companions. For I will endeavour to communicate all theſe Things to them, and try to deal with their Prejudices as you have done with mine.

P. Your

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P. Your Design proceeds from a right Disposition, *Matho:* There is not a more generous and rational Pleasure than that of communicating Knowledge and Truth to another rational Being: Nor can any Method be more effectual to rivet these Things *deep in* your own Mind, than by casting about to find out the best Way to make others conceive them.——

M. As to the Method of measuring the Earth, I have a Notion of it in general: The hardest Things must have a Beginning, and become familiar by Degrees: Pray go on therefore as you begun, to tell me Things as they really are: Though they may be above my Reach, something will still stick with me. Wherefore,

XXII. Pray inform me how far the Moon is distant from us?

P. Have you any Thoughts of making a Trip thither?

M. I wish the Thing were practicable.

P. The Length of the Journey, I am afraid, would discourage you.

M. How far may it be?

P. After we know the Length of the Earth's Semidiameter, and the Angle which that subtends at the Moon, by two Lines drawn from its Extremities to her Center, it appears that her Distance from us is about 60 of these Semidiameters, or nearly 240000 Miles.

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M. That is indeed a Journey not to be made in the Space of one Night: And in the Day-Time there is ſcarce any finding one's Way, which is ſomewhat ſingular. But how large a Body may the Moon be, if compared with our Earth?

P. The Diameter of the Earth is near four Times longer than the Diameter of the Moon; which, (among other Methods) is known from the Breadth of the Earth's Shadow, where the Moon paſſes through it.

M. That is to ſay, three or four Moons might be contained in it at one another's Sides.

P. You are right. Whence the Face of our Earth would appear about fifteen times bigger to a Spectator at the Moon, than the Face or *Diſk* of the Moon (as it is called) appears to us here.

M. How can it appear fifteen Times bigger? It ſhould only appear, I think, three or four Times bigger.

P. You will naturally imagine ſo, *Matho*, till you are better ſkilled in theſe Matters. But here is a Figure of the very Thing we are ſpeaking of. This larger Circle, which repreſents the Breadth of the Earth's Shadow where the Moon paſſes through it, contains the leſſer you ſee, which repreſents the Moon more than three Times; yet the *firſt* is much more than three Times the *laſt*.

M. I find I was quite miſtaken; yet I might eaſily have rectified myſelf, by imagining the Figures drawn.

P. This

P. This will surprize you more; if a Body like a *Dye* hath its Side twice as long as another of the same Sort, it will be equal to eight Times that other: Which may be seen by cutting any soft Body into such Shapes. The second Conference.

M. I have almost a Notion how a Piece of Apple, or Turnep, might be so cut, as to make eight such small Dice out of a larger one.

P. I presume you are not altogether a Novice at this Work.

M. Not quite; if this were as helpful as *projecting Shadows on the Wall.*

P. It is at least as helpful. The Imagination is best informed from the Eyes: However, as it is necessary you should understand how this is in general; if you will come here at any of your leisure Hours, we will amuse ourselves a little with *drawing* and *cutting* Figures. The Thing will easily become plain that Way, as well as by Numbers.

M. I will not fail.——But pray do me the Favour to inform me next, how far the Sun may be distant from us?

P. I have told you just now, *Matho*, that we find the Distance of the Moon, by the Help of the Semidiameter of the Earth, the Length of which we know: But the Distance of the Sun is so vastly great, that the Earth's Semidiameter hardly bears any Proportion to it. For those, who tell us there is a certain Proportion between them, are far from being agreed what it is. Some say the Earth's Semidiameter is about the 15000th Part of the Sun's

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Distance; others, that it is only a 20000th Part of it: But others affirm that it is considerably less than the 300000th Part of it.

M. This indeed is equal to saying nothing.

P. According to this last Opinion, the Distance of the Moon from the Earth is not the 500th Part of the Sun's Distance from it.

M. Strange! How prodigious must the Sun's Velocity be then!

P. What Velocity?

M. That whereby he makes a Revolution round the Earth in twenty four Hours. The Moon, though so much nearer us, requires still somewhat longer Time.

P. Cynthia, you know, a delicate Virgin, cannot be supposed to keep up with her brother *Phœbus*.

M. I do not want to hear the *Poets*, but the *Philosophers*.

P. Or perhaps it is the Law of these Motions, that the most distant Bodies should perform their Revolutions round the Earth in the shortest Time.

M. It is excusable in me, *Philon*, to be hitherto ignorant of the Laws of these Motions; therefore pray inform me what prodigious Force drives the Sun round the Earth every Day, though removed to such an immense Distance from it?

P. You might also ask me, *Matho*, what Force (yet more prodigious) drives round all the other cœlestial Bodies; the Stars which are without Number, and the starry Frame of Heaven

Heaven itself. These are placed at a much greater Distance than the Sun, and perform their Course somewhat sooner: So that, as I said, the most distant, at this Rate, must finish their diurnal Revolution in the shortest Time.

M. That is, indeed, what I should have asked: The Difficulty, I see, is vastly increased!——Well, this only heightens my Curiosity and Desire the more: Unravel therefore these Wonders, and tell me whence the Mighty Force proceeds, which thus whirls round the whole Frame of Nature in the Space of one Day?

XXIII. *P.* I could easily shew you such a Trifle as this, if you would explain to me by what Force this Chamber we are in, and even the whole House itself, whirls round this little Globe I have in my Hand, with such Rapidity every Moment.

M. Why do you put me off, *Philon*, in this joking Way, which is nothing to the Purpose? The Chamber does not wheel round that little Globe, but you twirl the Globe about with your Fingers, while the Room and whole House remain immoveable.

P. If it be so here, *Matho*, I am afraid you will find it so in the other Case: For consider, this little Spot you see here is our Island of *Great Britain*; and let the *Window* there represent the Sun. Now *Britain* being in this Position, or directly opposite to the Sun, we have Mid-Day; but as the Island moves thus

to

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to the *East*, the Sun seems to decline towards the *West*; and afterwards to set beyond the Mountains, as it loses Sight of him. The Motion thus continuing all Night, when *Britain* hath got through the Shadow of the Earth, and begins to turn about again to *the Rays* of the Sun in the *East*, he seems to be rising in that Quarter, and gradually to mount up the Sky, as *this Spot* turns toward him; till it is again directly opposed to him, and the diurnal Revolution finished.—Now, *Matho*, is what passes in the Heavens different from this Representation of the Matter which I have given you?

M. Softly, *Philon!* the two Cases are quite different, I see plainly the Heavens carried from *East* to *West*, while the Earth stands still: But here, on the contrary, the Chamber and Window have no Motion, only you turn this little Sphere in your Hand.

P. Certainly, *Matho*, you do not perceive the Heavens to move more than the Earth; nor the Earth to rest more than the Heavens: Only after some Time you see that the Part of the Earth, where you are, hath changed its Situation with respect to the heavenly Bodies. Wherefore your *Sense* doth not shew you either the Motion of the Heavens, or the Rest of the Earth, which you stand upon. And did not you yourself, at our first Meeting, say, *You wondered how the Sun moves over so large a Space every Day, and yet seems not to stir out of the Place?*

M. To

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M. To own the Truth, I find now, I do not *see* the Motion of the Sun or Heavens, but *infer* from my having changed Situation with respect to them, that they move and the Earth stands still.

P. If this be all, would it not be as agreeable to Reason to infer from this Change of Situation, between the Parts of the Earth and the heavenly Bodies, that the Earth moves, and the Heavens stand still?

M. I begin to be staggered.

P. Where the Informations of our Senses are doubtful, we ought to consider the Reasons of Things, and determine according to them, leaving the Informations of Sense quite out of the Case.

M. That is but reasonable, if once we were certain that the Informations of Sense were doubtful in this Point.

P. We will therefore examine the Point more narrowly.

XXIV. Wherefore let us suppose that the Earth *really moves round* on its own Axis from *West* to *East*, and that in the same Time in which the Heavens seem to be carried round from *East* to *West:* And then tell me what Changes would happen from this *real Motion* of the Earth, according to the Information of your Sense?

M. I cannot indeed be positive.

P. Consider if these are the Changes which would happen. The Parts of the Heavens towards

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towards the *East* would come in Sight one after another, while like Parts on the *West* would go out of Sight in the same Manner: Or on the *East* some Parts of the Heavens would always be rising, and on the *West* others always be setting; the middle Parts moving gradually to the same Hand. And in four and twenty Hours the whole Heavens would thus seem to rise and set. Are not these the Appearances we should observe on this Supposition?

M. They are so in Truth. For I perceive now from what is said before, it is the same Thing as if, the Earth standing still, a Man were carried with the like Velocity from *West* to *East*, who must see the Heavens and Stars thus to rise up before, and sink down behind him, as you shewed me when speaking of the Method of measuring the Earth. I plainly see that the Earth's carrying the Man from *West* to *East*, or the Man's moving over the (immoveable) Earth, with the same Velocity, and to the same Hand, could not alter the Appearances of the heavenly Bodies seeming to rise as he advanced to the one Side, and set as he retired from the other.

P You will easily perceive, *Matho*, since the Motion of the Earth on its Axis must be equable and smooth, without Succussion or Jolts; and since we see such a large Portion of its Surface round us, the Parts of which are all relatively at Rest among themselves, and with respect to us, who must be carried along with

with them: I say you will easily perceive from thence, that we could be sensible of its Motion no otherwise than by observing the Horizon (as it is called) where the Earth seems contiguous with other Objects; for all the Changes produced by its Motion must appear there.

M. I apprehend perfectly what you say, and see the Truth of it. A blind Man could not be sensible of his being carried along in a Coach, or any other Way, unless it were by the Succussions or Jolting; nor a Man with his Eyes open, unless he perceived himself to draw nearer to some Objects, or leave others farther behind him: Neither of which Circumstances can be in the Motion of the whole Earth.

P. Moreover, that the Sun or Stars seem to rise higher and higher above us, ought to create no Prejudice in our Minds against the Earth's moving, and their standing still; for since *over our Heads* is always *upward* to us, they will seem to rise higher in the Heavens as we are turned more toward them.

M. This is easily conceived; for while the Sun is highest to us at Noon, he seems to be mounting up from the *East* to those that are *West* of us, and low sunk in the *West* to those who are *East* of us. ——

P. Well, are not the Changes I named those which would appear, if the Earth moved, and the Heavens stood still?

M. They are.

P. Are

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P. Are they not the ſame too with the Changes that really appear?

M. They are.

P. Could any one then on this Suppoſition conclude that the Heavens moved?

M. If he did, he would conclude very falſely.

P. But ſince the Changes really happen now, which would happen from the Motion of the Earth, can a Man fairly infer from them that the Earth ſtands ſtill?

M. Since you have ſhewed me ſo convincingly that the Changes, which I ſuppoſed would happen if the Earth ſtood ſtill, are preciſely thoſe that muſt happen if it moves, I am ready to give up the Queſtion.

P. Let us go a ſtep farther if you pleaſe, and ſuppoſe that the Earth moved ſo ſwiftly round its Axis, that our Iſland would return to the Sun (by Suppoſition immoveable) every Quarter of an Hour; in that Caſe what Motions do you think ſhould we perceive?

M. We could then no more perceive the Motion of the Earth than at preſent: But the Sun and Stars would ſeem to roll over our Heads with the Swiftneſs of a Bird flying: And the Stars near the Horizon (where the Motion muſt be chiefly perceived) would appear to run along the Tops of the Hills with ſurprizing Celerity. In which Caſe indeed even our Senſes would ſeem to inform us of the Motion of the heavenly Bodies.

P. But would they inform us truly?

M. Nay,

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M. Nay, their Information then must be the greatest Fallacy.

P. Our Senses inform us, *Matho*, that the Moon moves to the *North* with the same Celerity that the Clouds below her fly towards the *South:* They inform us that the *Trees*, *Houses*, and other Objects on the Shore, draw back from the Ship in which we are, while she goes out of the Harbour.

M. Enough, *Philon*, I give up the Point. I am satisfied our Senses can in no Case prove to us the Motion of the Heavens; and that we are to be determined by Reason, and not the dubious Appearances from Sense.

XXV. But what Reason can be given why the Earth should move rather than the Heavens?

P. The Earth perhaps is rooted in some immoveable Basis.

M. I do not pretend that hinders it.

P. And what Reason then, *Matho*, *can not* be given, why *one single Body*, and that one of the smallest, should not revolve on its own Axis in the Space of twenty four Hours, rather than that all the World, infinitely larger in Bulk, should be carried round in the same Time with inconceivable Rapidity, as being placed at an immense Distance from it: And all this to no other Purpose than to bring about the *Vicissitude of Light and Darkness* to this one little Body?

M. This really would be something like supposing your Chamber-Window and the whole

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whole Room to be carried round the little Sphere, rather than that the Sphere itself should be turned to the Light.

P. Let any Person, *Matho*, who contends that the Earth does not move, say, whether it receives any other Benefit from this whirling round of the whole Heavens, than the enjoying the Vicissitude of Light and Darkness every four and twenty Hours.

M. I see no other Advantage it can be said to receive.

P. But if the Sun alone could procure it this Advantage, by his revolving about it every Day; to what Purpose is it to bring in so many huge Bodies to perform this Effect, which do not contribute one Jot towards it?

M. As this would be quite superfluous in Nature, so the Supposition seems to be very unnatural.

P. Wherefore, since they cannot suppose such a diurnal Motion in the Sun alone, without supposing the whole Universe to be at once carried round; it is certainly more reasonable in every respect, to acknowledge the Rotation of the Earth on its own Axis, than to raise such an Infinity of Motion through all Nature to no End.

M. This is really so absurd, that one cannot help conceiving an Indignation to hear that it is contended for: And I should think the Opinion must have prevailed at first, because Men were ignorant how small a Body the Earth was, and of what Figure: For as a

spherical

spherical Figure is most proper for such a Rotation round an Axis, so it seems designed for this Motion.

P. And that it is more spherical or protuberant about the Equator, and flat towards the Poles (which I observed to you before) is owing to this diurnal Rotation: But we must content ourselves with barely mentioning this Particular at present.

M. And yet I have some faint Notion of what you say: For if we again imagine the whole terraqueous Globe to be fluid, I plainly see it could not thus roll round on its own Axis, without *rising* or *swelling* a little towards the Middle: And since the dry Land follows the Figure of the Ocean, or fluid Part of the Globe, I can easily allow that the whole terraqueous Globe must have such a Figure.

P. This is helping yourself to right Conceptions of this Matter, from a Circumstance I had forgot.

M. I fancy too I now see the Reason of a Particular, which you mentioned before; but left the Explication of it till a more proper Time.

P. Pray put me in mind of it.

M. You said the Weight of the large Tracts of Mountains on the several Parts of the Earth must balance each other. Now if the Earth had such a *Bunch* on one Side, without any Thing to balance it on the other, the Motion I conceive could not be smooth and equable, but *unequal* and *hobbling*. Unless our Tops

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were rightly balanced and round, we could never get them to go ſmooth, or *ſpin*, as we call it.

P. Your Diverſions, *Matho*, are frequently of Uſe to us. If the Earth had ſuch an Excreſcence on one Side, without any Thing to poiſe it on the other, that would diſturb its *ſpinning* on an Axis, and at laſt ſpoil the habitable Globe. Take a Ring with a ſmall Stone in it, and give it a ſmart twirl on a ſmooth Table, ſo that the Stone may be about the Equator or middle of the Ring's Motion, and you will find the Ring will not whirl round with the Stone in that Poſition; but the Stone will riſe up till it be in the Pole of the Ring's Motion, and there it will keep. But if there were a like Stone on the other Side, they would both keep to the Equator, becauſe of their equal *centrifugal Force*, as it is called.

XXVI. *M.* You mentioned alſo another Particular lately, when ſpeaking of the ſpherical Figure of the heavenly Bodies, which ſeems ſtill to ſhew us farther how natural it is that the Earth ſhould have a diurnal Revolution on its Axis, and not the whole Heavens with all the innumerable Bodies in them.

P. Let me know what it was.

M. You ſaid *ſome of the cæleſtial Bodies, and among theſe the Sun himſelf, are always turning round, and ſhew us ſucceſſively all their different Sides*; which, if it be ſo, why ſhould not the Earth turn round likewiſe on its Axis, rather than

than all the Heavens keep such an eternal whirling to save it the Trouble?

P. It is very opportunely remembered, *Matho*; for *Jupiter*, the largest of the Planets, and far surpassing the Earth in Magnitude, is observed to roll round on his Axis in less than ten Hours: *Mars* performs a Revolution on his Axis in the same Time nearly as our Earth; and *Venus* in about twenty three Days, as has lately been discovered: Though *Saturn*'s great Distance from us, and *Mercury*'s being too near the Sun, has hitherto hindered the same Observation from being made upon them. Now laying aside all the other Reasons already mentioned, it is perfectly agreeable that the Earth, which is itself one of the Planets, should have the same Motion as the rest of them have (as far as our Observations can reach;) and that too a Motion so necessary to the Nature and Condition of a Planet. Nor is it less absurd in us, the Inhabitants of this Globe, to contend that the whole Heavens should wheel round in twenty four Hours, to answer its Necessities, rather than allow the Globe itself to move; than it would be in the Inhabitants of the Planet *Jupiter* (if any such there be) to maintain that the Heavens must roll round that Planet in ten Hours, that all its Sides should enjoy the Light successively, rather than grant that their Habitation should have such a diurnal Motion.

M. And yet they would have the same Reason to contend for the one, as we have to con-

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tend for the other; since *Jupiter*'s rolling round on his Axis in ten Hours would make the whole Heavens appear to them to turn round in that short time, just as they seem to us to turn round in four and twenty Hours: Though it is plainly impossible that one and the same Revolution should be performed in twenty four Hours, and in less than half that Time.

P. You run the Parallel between the two Suppositions very exactly, and might still go farther: For to a Spectator on the Planet *Mars*, the Revolution of all the cœlestial Bodies would seem to be performed in about twenty four Hours; and only in almost as many Days to one carried round on *Venus*. In short, if all the Planets turn round on their Axes in different Times; the cœlestial Bodies, though unmoved, would seem, to Spectators placed on these Planets, to revolve in as many different Times. Nay if any great Body rolled on its Axis from East to West, while others really turn from West to East, the Sun and Stars, to the different Spectators, would appear to turn from West to East, and the contrary Way, at one and the same Time.

XXVII. *M.* I am satisfied from this Variety of Cases, that the Senses are bad Judges of the *reality* of Motion. But some Things you said just now raise my Curiosity to a great Degree.

P. What are they?

M. I

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M. I would gladly know in the first Place, why the Planets perform their Revolutions on their Axes in such different Times, without any Respect, it seems, to their Magnitudes; as also, if it be yet discovered how much higher the Earth is about its Equator, than at the Poles; and if *Jupiter*, which rolls round so much sooner, hath his Equator thus raised?

P. It will be proper, *Matho*, to delay the Consideration of *these Niceties* for some Time.

M. Let it be so then: But as you have made Mention of several Planets, which, as far as I can gather from your Words, seem to be of the same Nature with our Earth, which you also called a Planet; and as you spoke of the *Distance* of *Saturn*, the *Magnitude* of *Jupiter*, and the *Nearness* of *Mercury* to the Sun, pray explain this Matter more fully. As these Things are quite new to me, I imagine they must be very entertaining; especially, since you spoke as if it were not impossible that the Planet *Jupiter* might have some Inhabitants residing on him.

P. To satisfy you in some Sort, I shall shew you, in few Words, the true Constitution of what is called the *Solar* or *Planetary System*, and give you a Scheme of it, done by a careful and curious Hand, which will make the Thing more intelligible than Words can do.

M. I am glad of that; for, as you observed, *the Imagination is best informed from the Eyes.*—

P. In the Center of the whole System is the *Sun* himself, which, notwithstanding the diminutive Appearance he makes to us at this Di-

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ſtance, is an *immenſe Ocean* of Heat and Light. Next to the Sun is the Planet *Mercury*, which performs a Revolution round him in about three Months time; for *Mercury*'s Motion is more ſwift than that of any other Planet. As he never removes far from the dazling Light of the Sun, it is difficult to get a View of him; yet ſometimes he is ſeen as a dark Spot on the Sun's Diſk, as he paſſes betwixt him and us. Above *Mercury* is *Venus*, which makes a fine Appearance in the Heavens, ſeeming to dart a ſtrong and beautiful Light. She finiſhes her Circuit about the Sun in two hundred and twenty-five Days, or ſeven Months and a half nearly. Next to *Venus* is our *Earth*, which together with the *Moon*, as an *Attendant*, completes its Courſe round the Sun in the Space of a Year, in which Time the Moon revolves about it, as a Center between twelve and thirteen Times. Above our Earth is *Mars*, being the fourth in order from the Sun, and takes up near two Years, or ſix hundred and eighty ſeven Days in moving round him: For the Motion of the upper Planets becomes always ſlower. At a great Diſtance above *Mars* is *Jupiter*, the ſtatelieſt and moſt majeſtick of the Planets. He hath four Moons, not unlike *ours*, rolling about him, one without another; which, conſidering the ſhort Duration of their Revolutions, afford a delightful Spectacle, and conſtant Variety of Appearances to a Spectator there. This Planet requires little leſs than twelve whole Years to complete his Period round the Sun. Laſt of

all

all comes *Saturn*, and closes up the *planetary Chorus*; for his exterior and ample Orbit surrounds them all. As he is the remotest from the Sun, he incloses the System with State and Dignity, having a miraculous Sort of an *Arch* or *Ring* about him, in which he seems to hang pendulous; and without that Arch are five Moons, which attend him through his whole Course, as the Moon does our Earth. The Motion of this Planet being the slowest of all, before he can finish his tedious Journey round the common Center of the Planets, it is twenty nine Years and near an half.—— These are the *seventeen Bodies* that make up the Solar System; and, as I said, this Scheme will represent to you their Order from the Sun, and the Orbits, as well of the six *primary* Planets, as of the ten Moons, or *secondary* Planets, which are also called *Satellites*. You have likewise marked on the same Sheet their *periodical Times*, and the Proportion of their Distances from the Sun, with other Particulars necessary to be known, which I would advise you to imprint on your Memory; for every Thing in this System is *Proportion* and *Regularity*.

M. I shall endeavour to obey you. But these seventeen Bodies are but a small Part of those Lights we observe in the Heavens.

P. And but a very small Part of them too: For beyond the Limits of our planetary World, and at an immense Distance without the Orbit of *Saturn*, are the *fixt Stars*,

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which you see sparkling in a *Winter Evening*, with such various Splendor and Magnitudes.

M. How pleasant must the intelligent Contemplation of these Things be, when the bare hearing of them, and looking on this *Diagram*, throws me into such an Extasy of Wonder and Delight!——But here again I must beg a Respite of you for some Days, till I digest a little in my Mind these different Particulars: Lest the *Novelty* and *Variety* should make me either confound or quite lose them.

P. You call the *renewing* of your Toil a *Respite* from it: But I willingly consent to what I had designed to have asked of you, if you had not prevented me.

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Objections against the diurnal Motion of the Earth on its Axis answered. The difference between absolute and relative, true and apparent Motion, familiarly explained. Of the Magnitude of the Sun in respect to the Earth. A Reason why the Sun should be so big. The Arguments which shew the annual Motion *of the Earth. How that Motion is known by the Stars in the Night Time. That the great Changes in Nature, with respect to us, are owing to the diurnal and annual Motions of the Earth. How the Vicissitudes of the* Seasons, *and lengthening or shortening of the Days and Nights are caused by these two Motions.*

XXVIII. *P.* I Am glad, *Matho*, to see you here again. How do you like the Subjects we were upon in our last Conversation? The third Conference.

M. Extremely well; for I think I enter into the Reasons of Things pretty exactly, and have got by Heart what only required Memory.

P. Have you no remaining Doubts concerning the diurnal Motion of the Earth on its Axis?

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M. I went away, you know, full of it; and am ſtill ſatisfied of the Reality of that Motion; but was not able to ſatisfy my Companions, ſo as to bring them over to my Side.

P. Why ſo?

M. They obſerved, if we throw a Stone directly up, that it falls down juſt at our Feet again. But if the Earth whirled with ſuch Rapidity from Weſt to Eaſt, the Part, from which the Stone was thrown up, muſt be carried a conſiderable Way eaſtward, while the Stone is in the Air; ſo that it would fall to the Weſt of the Part from whence it was caſt up.

P. This is a very common Prejudice, and pardonable in young People.

M. From this I raiſed ſome other Difficulties to myſelf; as why the Birds, when they fly, do not ſeem ſtill to be carried weſtward, while the Earth moves ſo ſwiftly below them the contrary Way. I have alſo obſerved, if I run with ſome Violence, a Breeze always meets me in the Face, though there be no Air ſtirring: Whence I think there ought conſtantly to be a ſtrong Wind from the Eaſt, while the Place we are in is carried from the Weſt with ſuch Velocity. If theſe Difficulties could be eaſily removed, I ſhould be able, I think, to deal with my Adverſaries.

P. Before they can be removed, you muſt underſtand a certain *Maxim* in Philoſophy, which is, *That a Body placed any where, partakes of the Motion of its Place.*

M. Explain the Maxim by an Example.

P. If

P. If a Ship be under Sail, and move ſmoothly along, the ſeveral Motions of People below Deck, or walking above, are performed in the ſame manner, as if the Ship ſtood ſtill. The third Conference.

M. This I underſtand tolerably well; for though I was never at Sea, yet I have been in a Ship while ſhe was going out of the Harbour: But ſtill it does not ſatisfy me. I think it ſhews rather, that a Body, which is contained in a Thing, partakes of the Motion of that Thing which contains it; be it Ship, Veſſel, or whatever elſe we pleaſe to ſuppoſe. How can the Earth be ſaid to contain the *Stone*, or *Bird*, which is in the Air? Or how can it be the *Place* of theſe, when quite ſeparated from it?

P. You are hard to pleaſe, I find: But ſince this will not do, let us come to another Inſtance.——Suppoſitions, you know, coſt nothing; and provided they be not impoſſible, we may make them at Pleaſure, in order to reaſon from them.

M. This I have obſerved from ſome Suppoſitions you have made before.

XXIX. *P.* Suppoſe then there was a *Plain*, like the Floor of this Chamber, moving ſmoothly along the Ground, which you may alſo ſuppoſe to be level like a Bowling-green; and we may imagine this Plain to be extended to any Breadth we have a Mind. Let us likewiſe ſuppoſe, that a *Frog* is carried along upon it.

M. I long to ſee the Event of this Suppoſition.

P. You

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P. You will eaſily allow that the Frog would leap, and perform all its Motions on this Plain, in the ſame Manner as if it had no Motion.

M. Certainly; for it is the ſame Thing as if ſhe were on the Deck of a Ship.

P. I ſhall go on then with the ſeveral Caſes of my Suppoſition, without expecting your Aſſent, or Diſſent, 'till I have done: And then you may give me your Judgment.

M. We ſhall, indeed, ſave Words by that Means.

P. If the utmoſt Extent to which the *Animal* could leap was two Feet, it could leap ſo far on the Plain, whether that moved, or ſtood ſtill. Imagine now the Creature to jump two Feet in a Direction preciſely oppoſite to the Direction of the moving Plain, and that the Plain moved juſt two Feet in the Time of the Frog's Leap, or while it was in the Air. Here it is evident that the Frog, taking its Leap the contrary Way to the Motion of the Plain, would reach two Feet from the Place it ſtood on: But by Suppoſition, the Plain moves juſt as much the contrary Way. If therefore there were a Hole in the Plain juſt where the Frog was to light, it would fall on the ſame Part of the Ground, over which it ſtood when it began to jump. This is the firſt Caſe. Suppoſe now it jumps the other Way, or in the ſame Direction with the Motion of the Plain; it will then likewiſe reach two Feet from the Place it ſtood on, and the Plain moves two Feet

Feet the same Way in the same Time: So that if there was a Hole in the Plain where the Creature was to light, it would fall on the Ground four Feet from the Place above which it began its Leap. In the first Case, the *yielding*, or contrary Motion of the Plain, when the Animal pushed it to begin its Leap, has such Effect, that it carries the Creature as much backward, as its own Effort carries it forward: So that with Respect to the Ground below the Plain, it neither moves backward nor forward; nor has its Jump any other Effect, than if it had leapt perpendicularly up, and fallen down again. And any one, not carried along, but observing the Motion of the Animal, without attending to that of the Plain, would imagine that it rose, and fell back perpendicularly. In the second Case, the conspiring Motion of the Plain carries it twice as much forward, with Respect to the Ground below, as its own single Effort could do.

M. Pray let me speak a Word.

P. That is against Conditions.

M. One single Word, to tell you that I conceive this, and have observed, when some of us have been in a Boat, and rowing against the Stream with all our Might, all we could do was only not to be carried down, but keep opposite to the same Part of the Bank of the River: But if we rowed down with equal Force, we made Way at a great Rate. I have done.

P. Let

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P. Let us ſuppoſe in the third Place, that the Frog jumps to a Side with Reſpect to the Direction of the Plain's Motion, or two Feet ſtraight outward; and imagine that on the Ground below, from the Part over which the Creature makes its Leap, there is a *Square* deſcribed for two Feet outward, to the ſame Side. The Animal will leap ſtraight outward, to a Point two Feet diſtant; and that Point is, in the interim, carried two Feet downward, by the Motion of the Plain: So that if there were a Hole at that Point, it would light juſt in the oppoſite Angle of the Square on the Ground; and muſt therefore, while it jumpt ſtraight outward with Reſpect to the Plain, have always been above the Diameter, or *Diagonal* of the Square, with Reſpect to the Ground.

M. I beg you would hear me but one Word again.

P. Then you may go on by yourſelf, *Matho*.

M. You'll own it is worth your while to hear me. I can ſhew this by a Piece of Paper moving along another Piece of Paper; and that by drawing a Line ſideways on the upper Paper, and a Square below that on the under Paper, as you ſuppoſed to be done on the Ground, a Creature, that moved from End to End of the Line, ſhould move from Angle to Angle of the Square below. Do I not rightly apprehend it?

P. You do indeed. In the laſt Place then, let us imagine that the Creature jumps perpendicularly up, and that the Time or Duration

tion of the Leap is the same as before. It must fall down again on the same Part from which it rose, as well when the Plain moves, as when it stands still: For in the former Cases, its Distances on the Plain were the same, as if that had been without any Motion: But this Place it alights on now is carried down two Feet, while the Animal is in the Air: And if there were a Hole there, it would fall on the Ground two Feet below the Place from above which it rose. With Respect to the Plain, therefore, its Motion is a perpendicular Ascent and Descent; but with Respect to the Ground, it is such a *Curve*, as a Frog commonly describes, when it leaps upon the Ground. Now, *Matho*, you are at Liberty to speak——

XXX. *M.* I conceive this well enough; but am studying to find out some Way to represent the two different Appearances of this single Motion.——Suppose the Plain moving on the same Level with the Top of a Wall, and that you were on the other Side, not seeing the Plain moving along, but only the Animal as it mounts up and comes down; though it comes down on the same Part of the Plain from which it rose, you would think that it jumpt along the Top of the Wall.

P. Pou are right: The same Motion must make a different Appearance to one carried along with the Plain, and to another standing on the Ground. Imagine now, there was no more a Plain in all these Cases, but only that the

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the Part the Animal ſtands on hath the ſame Motion the Plain was ſuppoſed to have; and the Diſtances on the Ground, and the Places of alighting, will be the ſame as before. The Creature would either fall on the Place immediately below where it ſtood, four Feet downward; move above the Diagonal of a Square; or fall two Feet below, as in the ſeveral Suppoſitions above. For the Exiſtence of the Plain hath no Effect on its Motion while it is in the Air.

M. I am entirely ſatisfied about every Particular of this; nevertheleſs, when you ſum up all in ſo few Words, the Thing ſeems ſcarce credible. I am ſure I could not have underſtood it, without the ſeveral Suppoſitions you have made.

P. Hence you will perceive what is to be ſaid to the Objection of a Stone thrown perpendicularly upward.

M. I perceive, though it riſes and falls perpendicularly, with Relation to the Ground, yet abſolutely ſpeaking, it is carried along with the Earth all the Time, or partakes of its Motion to the Eaſt; juſt as the Animal was carried along with the Plain, becauſe it took its Riſe from that when in Motion.

P. You will likewiſe eaſily conceive, if the Stone be thrown eaſtward, or weſtward, (that is, *with*, or *againſt* the Earth's Motion,) it muſt ſtill be carried Eaſt; unleſs we ſuppoſe the Force, with which the Stone is projected, ſuch, that the Projection ſhould carry it as much

much West, as the Motion of the Earth carried it East. Then absolutely speaking, the Stone would neither move East nor West. And if the Stone were projected with still greater Force, it should really move westward. The third Conference.

M. I understand; for if, in the first Case above, the Jump of the Frog had been three Feet, in the Time that the Plain moved two, the Creature should have fallen on the Ground a Foot beyond the Place above which it made the Leap. I understand likewise, if the Stone is thrown neither with, nor against the Earth's Motion, but to a Side, that is, southward or northward, that in the Time it is carried South or North, with Respect to the Earth, it will also, by partaking of the Earth's Motion, be carried eastward; so that absolutely speaking, it will be carried South-east, or North-east, as where the Frog moved above the Diagonal of a Square.

P. Nor will you find it difficult to conceive how any other *Projectile*, a *Bomb*, or *Canon-Ball*, for Instance, must partake of the Motion of the Earth, in whatever Direction it is projected.

M. I perceive what may be said in all these Cases. The *Ball*, or *Bomb*, by partaking of the Earth's Motion, is thrown to the same Distance, and hits the Mark in the same Manner, as if the Earth did not move: So that such *Instances* as these can be no longer any Objection to the Earth's Motion.

P. As to your next Difficulty then.

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M. There is something that occurs, from what we have been saying just now, which I would willingly first speak to.

P. What is it?

XXXI. *M.* I am considering with myself, how really distinct *absolute* and *relative* Motions are; and yet how difficult it is sometimes to distinguish the one from the other.

P. Those who confound these two Motions, *Matho*, make their *Sense*, and not *Reason*, Judge of the Reality of Motion: But let me know, by an Example, where your Difficulty lies.

M. In the Instance you gave just now of *a Body projected to the West, with the same Celerity the Earth is carried to the East*, we should fancy it to move very swiftly to the *West*, and be ignorant, in the mean while, that we ourselves were only moving with that Celerity to the *East*.

P. This is no more than what you yourself observed before, when you said you were satisfied from a Variety of Instances, *That the Senses are bad Judges of the Reality of Motion.*

M. This I said, and am still convinced of it; and that we are to judge of real Motion by Reason, and not the dubious Informations of Sense. But I would know the true Difference between real and apparent Motion, by the Help of which Difference Reason may distinguish between them.

P. The

P. The Difference in few Words is this, a Body may appear to move without any Force impressed upon it; that is, the Distance between it and other Bodies may be changed, without its receiving any Impulse to make it change its Place: But a Force must necessarily be impressed to put a Body in real Motion, or to stop it again when moving.

M. Therefore wherever there is a relative Motion, there must be real Motion in some of the Bodies?

P. Certainly; for if all the Bodies in the Universe were at Rest, the Distance between any of them could not be changed, unless a Force were impressed on some of them at least.

M. And on the contrary, wherever there is real Motion, there must be a relative Motion, or Change of Distance.

P. That doth by no Means follow.

M. Pray shew me how it can be otherwise: For I think they must necessarily accompany each other.

P. Imagine there was but one Body in Nature, as our Earth, and that no Force was impressed upon it; would it move, do you think, in that Case?

M. It could not without some external Force to put it in Motion.

P. Imagine then that some *Mighty Hand* impressed a Force upon it; and tell me what the Effect of that Force would be?

M. It would certainly be moved, whether any other Body existed or not, the Distance

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between which and it might be changed: For it is Nonſenſe to ſay that a *Force impreſſed and no Force impreſſed*, ſhould both have the ſame Effect.

P. You are right *Matho:* Real Motion doth not depend on Change of Diſtance, or the Exiſtence of another Body; though relative Motion doth. For take it thus; Imagine that two Bodies only were created in Nature, and a Force impreſſed on one of them ſufficient to move it with a certain Degree of Celerity; you know it would move on without End in the immenſe Space, and with the ſame Celerity ſtill.

M. You have already ſatisfied me of that.

P. Suppoſe then, after any Time, that the Body, on which no Force was impreſſed, were annihilated, or removed out of Exiſtence, by the ſame mighty Power that created it; and tell me then, would the taking away of this Body deſtroy the Motion of the other?

M. No more than taking my Ball off the *Billiard-Table* would hinder my Companion's from moving upon it.

P. Or ſuppoſe the Body to be reproduced again; would the *firſt Body* begin to move anew? Or would it move, or not move, according to the Exiſtence or Non-exiſtence of the other?

M. I am convinced of the double Abſurdity; either that a Body ſhould begin to move without a Force impreſſed, or ceaſe to move without an Obſtacle. This indeed is extremely pleaſant and intelligible.

P. Suppoſe

P. Suppose again that only our Earth and Moon existed, and that the Moon rolled about the immoveable Earth at the same Distance as at present. Here is both real and apparent Motion, because the Moon is successively opposite to the different Sides of the Earth: But if we suppose the Earth so to be turned round on its Axis, as to keep the same Side always exposed to the Moon, this will take away the relative Motion: Yet it would be foolish to maintain, that giving a Motion to the Earth on its Axis took away the Motion of another Body. The third Conference.

M. It would be a new Kind of Absurdity to affirm that, if both of them moved, neither of them could move.

P. Suppose again, that only two Bodies existed in Nature, and that both of them were put in Motion with the same Celerity, and in the same or parallel Directions, and there will be real Motion in both these without Change of Distance, or relative Motion. The same also might be shewn of any Number, or System of Bodies; if they were all urged in parallel Directions, and with equal Celerity.

M. This is all mighty clear.

XXXII. Now to my other Objection concerning *Birds* while suspended in the Air, which seems, I think, more difficult than the former.

P. On what are they suspended?

M. They support themselves in the Air, and fly through it by the Motion of their

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Wings, with which they ſtrike againſt the Air: For if you move a ſingle Feather ſwiftly you will find the Air make a conſiderable Reſiſtance to it, as I have often tried. But my Difficulty is not concerning their Flight, but how they partake of the Motion of the Earth, and are carried round with it, though raiſed above, and quite ſeparated from it.

P. Well, it is eaſy to conceive that Birds partake of the Motion of the Earth, even while they are in the Air; as much as the Frog did above the moving Plain.

M. I ſhould allow that it might be ſo, if the Flight of a Bird was ſuch a Motion as the Leap of a Frog; but it reſembles more, I think, the ſwiming of a Fiſh: For after they take their *Riſe* from the Ground, they move faſt or ſlow, as they have a Mind. And I have often obſerved a *Kite* ſeem to ſtand ſtill a conſiderable Time, without moving his Wings at all.

P. Tell me, *Matho*, how are the Fiſhes of the Sea carried round by the Motion of the Earth?

M. They are carried round in the Water of the Sea, which is carried round by the Motion of the Earth.

P. How comes the Water of the Sea to be carried round by the Motion of the ſolid Part of the Earth? For if you take a *ſhallow Veſſel*, not full of Water, and move it to one Side with no great Velocity, the Water will flow over the Brim of the Veſſel the contrary Way. Whence, as the Earth began to whirl ſwiftly eaſtward, the Water of the Ocean ſhould not have

have taken the Motion, but have flowed westward, till it had been spread all around the whole Surface of the Globe. The third Conference.

M. I suppose, when the Earth first received its diurnal Motion, the Force which produced *that* Motion was impressed as well on the fluid, as on the solid Part of the Globe; so that there could be no Hazard of the Sea's overwhelming the dry Land.

P. You are certainly right; it was as easy to impress the Motion on the one Part as the other: And without that the Effect could not have been completed. Besides a dreadful Commotion and Uproar must have ensued on the Face of the Earth, whilst the Waters dashed with inconceivable Fury against the solid Prominencies and Sides of Mountains. But if we were willing to suppose all this Tempest, the Event must at last have been the same as on your Supposition.

M. That I do not understand; pray shew me how it might have been?

P. It is not indeed to our present Purpose; but as it may give you fuller Notions of these Things, I shall endeavour to obey you. Though the Water of the Sea must at first have been put into a terrible Commotion, and spread round the Face of the Globe, it would gradually have taken the Earth's Motion, and at last been carried round with equal Celerity. And being then relatively at Rest, it would have sought the lower Parts, and formed the Ocean as at present.

The third Conference.

M. Pray explain the Caſe more particularly: This gives me but a confuſed Notion.

P. You know in the preſent State of Things, the Sea, Rivers, Brooks, *&c.* partake of the Earth's Rotation on it's Axis.

M. They do.

P. And moving with the ſame Celerity, they are relatively at Reſt with reſpect to the dry Land, or ſolid Part of the Globe.

M. The Sea, or a Lake, or Pool, is as much at reſt with reſpect to its Bottom, as a Stone with reſpect to the Ground on which it lies.

P. When the Water therefore moves with the ſame Celerity as the Earth on which it is, that doth not hinder it to run down in Rills, Brooks, and Rivers, wherever it finds a Deſcent.

M. It doth not indeed; for being relatively at Reſt with reſpect to the Ground, it runs down the ſame Way on any Declivity, as if the Ground were without all Motion.

P. Though the Motion on its Axis then had only been at firſt impreſſed on the ſolid Part of the Earth, ſo that on the firſt Commencement of the diurnal Rotation the fluid Part would have ſpread round the Surface of the Globe; yet in Time it muſt have had the Motion impreſt upon it, and at laſt have been carried round with the ſame Celerity as the ſolid Part.

M. It muſt indeed; for we cannot ſuppoſe it to have kept ſtill equally ſpread, without ſuppoſing it to be carried round with the ſame Celerity;

Celerity: And it could not gather into Heights because of its Gravity.

P. Therefore the Water on the Globe coming at last to have the whole Celerity of the Earth impreſt upon itſelf, or being relatively at Reſt with reſpect to the Earth, muſt have ſought to the lower Parts, and formed the Ocean according to the Hollows it found.

M. Now I ſee plainly that the Event muſt have been the ſame at laſt in either Caſe. But might we not likewiſe ſuppoſe, that the diurnal Rotation was impreſt by Degrees to prevent ſuch Diſorders?

P. We Mortals are forced to proceed thus gradually in moſt Things; becauſe we have neither Power nor Skill to do otherwiſe: But there is no Parity in the two Caſes. This Suppoſition however might be made, provided it be not underſtood as a Mark of Impotence in the Cauſe.

XXXIII. *M.* Well, all this is extremely pleaſant, and by it, I think, I perceive what may be ſaid in the Caſe of the Birds being carried round with the Earth, and partaking of its Motion.

P. How then could you ſatisfy yourſelf as to that Point?

M. The Air muſt partake of the ſame Motion with the Earth; ſo that Birds fly up and down in it, as if the Earth, or it, had no ſuch Rotation.

P. So far you are right: And how came the Air by this Motion?

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M. I imagine the ſame Motion muſt have been at firſt impreſſed on it, as on the *Earth* or *Sea*: For the Earth could not ſoon have impreſſed a Motion on ſuch a Fluid, ſo as to carry it about with equal Celerity. And all the intermediate Time, it muſt, by not moving along with the Earth, have raiſed dreadful *Tempeſts*, both on the Face of the Waters and dry Land.

P. A Motion of the Air, *Matho*, much leſs rapid than this would be, raiſes Storms which beat down Houſes, tear the Trees up by the Roots, and work the greateſt Deſolation both by Sea and Land. So that if we add the Diſorders of both *Elements* together (the *Sea* and *Air*) they are perfectly inconceivable: But their Rage we find is bridled down, and our Globe rendered habitable.

M. It is indeed amazing that our Bodies ſhould be conſtantly hurried along with ſuch prodigious Impetuoſity, amidſt ſuch furious Elements, and irreſiſtible Motions, and yet that we ſhould be as little incommoded by theſe, and even as inſenſible of them, as if nothing ſtirred in Nature! So little indeed that Men deny they are! The Liquor in the Cup is not ſhaken, the *Infant* that has but juſt Strength to ſtand upright is not moleſted, and every Thing is as ſtable and firm as if our Earth reſted on ſome eternal Foundation!

P. The Reflection is pertinent. If theſe Elements were not ſometimes allowed to break

looſe,

looſe, we ſhould be ignorant how powerfully our Safety was wrought.

M. From all this I now perceive that my laſt Objection to the Earth's Motion was entirely groundleſs: Since the Air is carried round with the ſame Velocity as the Earth, there cannot be a conſtant Wind from the *Eaſt* (as I fancied) ſweeping over the Plains of the Ocean, and bearing againſt the Sides of the Mountains.

P. There could not, ſince the whole Maſs of Air, or *Atmoſphere* (as it is called) is carried with equal Rapidity the ſame Way.

M. From hence I perceive, if a Body were ſuſpended above the Earth, ſo as not to partake of it's Motion, there would be a *furious Guſt* againſt the Weſtern Side of it, while the Air ruſhed violently by it to the *Eaſt*.

P. Such Body would rather be carried along with the impetuous Motion of the Atmoſphere; if not raiſed above the Height of it.

M. You have ſaid that the Moon is carried round our Earth: Pray is ſhe thus carried round by the Force of the revolving Atmoſphere?

P. Nothing like it, *Matho:* She is carried round by quite another Law of Motion, nor does the Atmoſphere reach ſo high.

M. How high doth it reach above the Surface of the Earth?

P. All *Appearances* in the Atmoſphere ſhew, that it doth not riſe one Semidiameter of the Earth above our Heads; and the Moon, you know, is ſixty Semidiameters from us.

The

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The true Limits of it, indeed, are not certainly known: The common conjecture is, that it doth not extend to above forty-five, or fifty Miles; though poſſibly a farther Conſideration of the *ſtreaming Lights*, which appear ſo frequently in the Air of late Years, may ſhew that it riſes conſiderably higher.

M. What Force then carries the Moon round the Earth, twelve or thirteen Times a Year? For that is a Point I want chiefly to be ſatisfied about.

P. Are not all the other ſecondary Planets, or Moons, thus carried about their *Primaries*; and the primary Planets themſelves thus carried round the Sun, the common Center of the Syſtem?

M. They are; and that makes the Solution of the Queſtion of greater Importance.

P. To tell you this at preſent would do you no manner of Service; it would be like ſpeaking to you in an unknown Language.

M. But if I come to it in a proper Time, it will relieve me of a Pain, as meat does of Hunger?

P. You are right.

M. Well, I deſiſt. But this brings to my Mind one ſmall Difficulty more, and then I have done with my Objections.

P. What is it?

M. It is with reſpect to our *upward* and *downward*. You allowed, and taught me, that *upward* and *downward* regarded only the Centers of particular Bodies, as our Earth, or the

the Sun: And yet in speaking of the Order of the Planets from the Sun, you said *Venus* was above *Mercury*, *Mars* above our *Earth*, and *Jupiter* above *Mars*; by which I understand, you reckon them all upward from the Sun. This perplexes me. The third Conference.

P. The Consideration of this Affair must likewise be put off till another Time.

XXXIV. However, from this I perceive you have the Order of the Solar System in your Head.

M. I told you I have every Thing by Heart that only requires Memory. I can set up the whole Scheme in my Imagination at any Time; but find it difficult to abstract from the Diagram on the Paper, and apply these Motions to the great Bodies themselves in the Heavens. Yet sometimes, when without Doors, I endeavour to suppose that I am carried round the Sun with the Earth; having *Mercury* and *Venus* on the inner Side, or between me and the Sun, with *Mars*, *Jupiter*, and *Saturn*, on the other Side.

P. That is not a bare Supposition, *Matho*, but according to the Reality of Things. You take the right Method in making yourself familiar with the Heavens themselves: They suggest quite other Notions, than Schemes within Doors can do; and a little Practice will make the Thing easy to you.

M. But while I am thus employed, many Things want Explication; and I have not you at Hand. *P.* You

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P. You will ſoon require a more ſkilfull Guide: But in the mean Time I ſhall convince you, rather of my Want of Ability than Inclination to ſerve you; and in this View only you may propoſe your Difficulties.

M. In the firſt place I would know what may be the true Magnitude of the Sun; becauſe I obſerved in your Deſcription of the Solar Syſtem, you called *him a vaſt Ocean of Heat and Light.*

P. I have told you already, *Matho*, that the Diſtance of the Sun from the Earth is ſo great, that any Method of meaſuring, hitherto contrived, cannot aſcertain it; though ſome of theſe Methods are extremely ſubtile and ingenious: And without knowing the Diſtance of the Sun, we cannot be certain of his true Magnitude.

M. I underſtand. They, who make his Diſtance from us to be 30000 Semediameters of the Earth, muſt ſuppoſe him larger; and they who make it leſs muſt ſuppoſe him ſmaller; that he may ſtill make the ſame Appearance to the Eye.

P. You are right. Now we ſhall leſs err in making him too large, if we ſuppoſe his Diſtance to be only moderately great: And if we imagine *that* to be about 20000 Semidiameters of the Earth, his Breadth, or Diameter, will be ſome more than ninety Times as great as the Earth's. And ſince the Diſtance of the Moon from the Earth is only ſixty Semidiameters of the Earth; if the Sun were placed where

where the Earth is, his Body would fill the whole Orbit of the Moon, and reach near 120000 Miles above it. The third Conference.

M. Prodigious! It is not without Reason that you called him *a vast Ocean of Heat and Light.*

XXXV. *P.* You will form a better Notion of the Largeness of the Sun's Body, from this coarse plain Representation of it, than by expressing the Proportion between it and our Earth in Numbers only. But this Scheme will shew to your Eye how large he is with respect to the other Planets, according to the Opinion of the *celebrated Monsieur Huygens*, who makes the Sun's Semidiameter a hundred and eleven Times longer than the Earth's.

M. Pray let me consider it.——What a different Appearance is this! The Sun here indeed makes a grand and noble Figure, in Comparison of the Planets.——Alas! What a small Thing is our Earth! How is it shrunk up!

P. Yet this is that *mighty Point*, about which the Sun, and all the Heavens too, should revolve every Day.

M. Here is *Saturn* I see encompassed with the *miraculous Arch* you spoke of. How much more justly might this Planet, or *Jupiter* there, which is indeed by far the greatest of the Planets, challenge the Pre-eminence of having the Heavens to roll about them? What a Difference there is between the Reality of Things and the Appearance they make!

P. That

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P. That Reflection, *Matho*, is equally applicable to moſt Things we know.

M. I no longer wonder that the Sun ſhould ſtill appear equally big over the whole Face of the Earth; for this is only to appear equally big over the whole Surface of a Point. Nor is the Reaſon hard, I think, to be found out, why he ſhould be ſuch a vaſt Body.

P. What Reaſon, think you, can be aſſigned for it?

M. It is, I ſuppoſe, becauſe the *Heat* and *Light* of the Sun were to be diffuſed through the whole Syſtem, as far as *Saturn* himſelf, whoſe Diſtance from the Sun, as I underſtand from the former Diagram, is near ten Times greater than the Diſtance of the Earth from him.

P. You are perfectly right, this is one Reaſon: But upon another Account alſo, a Body containing a prodigious Maſs of Matter was to be placed in the Center of the Syſtem.

M. Pray tell me on what other Account.

P. It would not give you half the Pleaſure, nor do you half the Service to have another tell it you, that it would do to find it out yourſelf; which I foreſee you will eaſily do hereafter.

M. I ſhall be directed by you.

XXXVI. In the mean Time it is proper to acquaint you, that ſome Philoſophers place the Earth, and not the Sun, in the Center of our Syſtem.

M. And

M. And how do they dispose of the Sun in that Case?

P. In the fourth Place from the Earth, having put in the *Moon*, *Mercury*, and *Venus*, between him and the Earth; about which they say he revolves among the rest of the Planets in the Space of one Year.

M. That is, having supposed the Earth immoveable in the Center, they ascribe its Motion to the Sun.

P. It is so: And I would know your Thoughts of this Disposition of the System.

M. Truly I think it is not quite so proper, that the noblest Body of the System should revolve about one of the least Bodies in it; and (which seems worse) that the *Fountain of Heat and Light* to the whole System (for such I think we may call the Sun) should leave the Center, the most proper Place for dispensing these equally, and go here and there, to chear one Part of it, while the other Parts are left languishing and uncomfortable till his return.

P. It would seem so to an unprejudiced Person.

M. Besides, *Philon*, after what you have shewed me concerning the diurnal Motion of the Earth, which the Sun and whole Heavens were brought in to supply, I would be cautious in ascribing the Earth's Motion to the Sun in any Case: For it looks suspicious as if this were only from mistaking *apparent* for *true Motion*.

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P. That Miſtake is indeed the Foundation of this whole *Hypotheſis.* But there is an eaſy Way of diſcerning how falſe the Hypotheſis is; for if the *Sun*, *Venus*, and *Mercury* finiſhed their Revolutions about the Earth in ſuch different Times, it muſt of Neceſſity happen, that, while the *Sun* is on one Side of the Earth in the Center, *Venus* or *Mercury* muſt be on the oppoſite Side; as now the Earth and either of theſe Planets are frequently on oppoſite Sides of the Sun. But this never happens, nor can happen, ſince the Sun is in the Center.

M. I think I underſtand the Force of this Argument, by the Help of my Scheme here: For ſince the Orbit of the Earth is exterior to that of *Venus*, or *Mercury*, they can never get to the Side of the Earth, oppoſite to the Sun. But if the Earth were placed in the Center, what happens to the Sun now would happen to the Earth then.

P. You are Maſter of the Argument; but will ſee the irreconcilable Difference better, by conſidering likewiſe this other Scheme, which repreſents the Syſtem of the World, according to the Opinion *of theſe* Philoſophers. It is called the *Ptolemaick*, as the former is called the *Copernican* or *Pythagorean Syſtem.*——

M. I ſee here indeed their Orbits in the Order you mentioned; and by comparing the two Syſtems together, the Force of this Argument appears very obvious.

P. There are beſides, *Matho*, other Appearances in the Heavens, which can never be naturally

turally accounted for, if we place the Earth in the Center of the System. For the other Planets seem to us, sometimes to *stand still*, and sometimes to *move backward*, instead of going forward, which is an Appearance they could not make to us, if we were in the Center of their Motions.

M. I perceive, by considering this last Scheme, that the Earth being in the Middle, all the other Planets must appear to it to move the same Way, some faster, some slower; and never to move backward: But I do not so well conceive, in the present Case, how any of them should seem to go backward, while they really move forward.

P. You know the Planets nearer the Sun perform their Revolutions sooner, on a double Account, both as their Motions are swifter, and their Orbits less.

M. This you mentioned before.

P. The interior or lower Planets then must seem, by their swifter Revolution, to cast the exterior Planets behind them, or backward among the fixt Stars.

M. I perceive it now, by looking to the first Scheme: And thus *Mars*, *Jupiter*, and *Saturn*, must seem to us to move back a little among the fixt Stars, as our Earth passes betwixt the Sun and them with a quicker Motion.

P. You have it exactly. A Spectator in the higher Planets likewise must think that the *interior* or lower Planets go backward, or move

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contrary to the Order of the Signs, as they pass more swiftly between the Sun and him.

M. This I apprehend from the former Case: If *Venus* past between us and the Sun, while *Mercury* moved on the other Side of him, though both proceeded the same Way, or followed each other, yet they would seem to meet and cross: Whence *Venus* must appear to go backward, or contrary to the other. But is this Observation easy to be made?

P. So easy, that you yourself may observe it in *Saturn* and *Jupiter* every Year; and in *Mars* and *Venus* once in two Years.

M. I am glad of that methinks: For it shews, I take it, both the *Copernican* Order of the Solar System, and the Motion of the Earth round the Sun, to a Demonstration.

P. But there is still a *more noble Argument, Matho,* which I would chiefly recommend to you, that you may pursue it, when more advanced in these Matters; because it illustrates and confirms the Order and Motions of the Planets round the Sun, in a Manner altogether particular.

M. Pray inform me what it is?

P. The *Times* of the Revolutions of the Planets round the Sun, and their *Distances* from him, are so connected by a certain Proportion, which flows from a natural Necessity, that one may venture to say, it is either Ignorance, or determined Obstinacy, that makes Men place the Earth in the Center of the System, since such a Disposition would ruin

the most beautiful Proportion, and struggles (unsuccessfully) against the strongest Necessity. The third Conference.

M. I beseech you tell me what that Proportion is, that I may at least get the Words by heart.

P. It is this, *The Squares of the periodical Times of the Planets round the Sun are always as the Cubes of their Distances from him.*

M. I shall imagine that this Sentence contains some notable Truth, and as such cherish it in my Memory.

XXXVII. But what is the Reason why these Philosophers ascribe to the Sun, not only a diurnal, but also an annual Motion round the Earth?

P. Just what you surmised lately; a mistaking the *apparent* for the *true Motion:* For while the Earth is carried round the Sun, the Sun seems to move the contrary Way. This Appearance they took to be real Motion in him: As if any one should fancy a *distant Tower* to move the contrary Way to that which he himself was going, because it successively intercepted the View of more remote Objects, in a contrary Order.

M. And yet at this Rate, the Sun, beheld from different Planets, (*Jupiter* and our Earth, for Instance,) would appear to move two contrary Ways at once, as the Planets themselves were carried to opposite Sides; which is absolutely impossible.

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P. And not only two contrary Ways at once, *Matho*, but (as was obſerved, with Reſpect to the diurnal Motion,) he would ſeem to be carried round the Heavens in very different Times. For a Spectator in any of the Planets would fancy *that Planet* immoveable, and impute both its Motion, and periodical Time to the Sun. Thus, to a Spectator in *Mercury* he ſhould appear to be carried round in three Months; and to another in *Saturn*, ſcarcely in thirty Years.

M. Nothing ſolid can be eſtabliſhed on an Appearance of ſuch an ambiguous, and equivocal Nature as this. But pray let me know how I may obſerve this annual Motion of the Earth; for we are not ſenſible of its moving thus.

P. You have not yet had Time to obſerve the Retrogradation of the Planets, which is one good Way of being ſatisfied of the Reality of the Earth's Motion; as you yourſelf obſerved but a few Minutes ago.

M. Pardon me; I did not reflect on that: But is there no other Way to know it?

P. You know you cannot perceive the Motion of the Earth with your Eyes.

M. That's true: We cannot thus perceive even its diurnal Rotation; but infer it from the Changes it produces round us.

P. It is the ſame here; you can only know the Earth's annual Motion from the Changes which that produces.

M. By what Changes ſhall I know it?

P. By

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P. By what Changes do you know one Day from another?

M. It is superfluous to ask that Question.

P. By what Changes then do you know the following from the former *Year?*

M. Every Year has its own Parts, as much as the Days have theirs.

P. Right; now as the diurnal Motion of the Earth on its Axis makes *Morning*, *Evening*, *Noon*, and *Night*; so its annual Revolution round the Sun divides the Year into *Seasons*, that have some Relation to the Parts of the Day, *viz. Spring*, *Summer*, *Autumn*, and *Winter*.

M. Pray do me the Favour to explain to me, how *these Changes* are brought about by this Motion of the Earth?

P. The Deduction of this Matter, I'm afraid, will fatigue you; for you must attend to a Variety of Circumstances at once: And after all, the Subject does not afford much Entertainment.

M. Is it not necessary to be known?

P. Scarce any Thing can be more so.

M. Where then can I better bestow a little Attention?

P. Since you are so resolved, we must go a good Way back: Wherefore tell me, do you know any of the *Constellations* in the Heavens by Sight?

M. None, except the *Pleiades*, *Orion*, and the *greater Bear*.

P. These are sufficient. Have you ever seen the Pleiades towards the End of the Spring?

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M. I do not indeed remember, whether I have obſerved them about that Time or not.

P. It was impoſſible you could, *Matho.*

M. Why was it impoſſible?

P. I ſhall tell you; and that ſo much the more eaſily, as you were wont ſometimes in your ſolitary Walks to make a *tour* round the Sun, together with the Earth.

M. I did that in Imagination only.

P. It will be neceſſary to do it in Imagination over again.

M. I ſhall endeavour to follow you.

XXXVIII. *P.* When now the Earth, in its annual Courſe, is got between the Sun and the Pleiades, (for you remember that the fixt Stars are far beyond the Limits of *Saturn*, and ſo at a great Diſtance without the Earth's Orbit;) when, I ſay, the Earth hath got between the Sun and *theſe Stars*, they become obſervable in the Night Time, as not being intercepted from our Sight by the Sun's Rays. And in this Manner they appear during the whole Winter; only they ſeem to get more weſterly every Night, as the Earth moves gradually by them to the Eaſt.

M. This I eaſily conceive: For the Sun and *they* being on oppoſite Sides of the Earth, (or *he* within, and *they* far without its Orbit) when it is Night we are turned towards them, and then they muſt be conſpicuous.

P. As the Spring approaches, the Earth by Degrees withdraws itſelf, from between the Sun

Sun and them, and moves forward to the opposite Part of its Orbit: Whence it comes to pass that the Sun, placed in the Center, seems to draw nearer to the Pleiades; till at length, the Earth thus advancing in its Course, the Sun gets between it and the Stars, which then lie hid behind his Rays. The third Conference.

M. This is extremely natural and easy to be apprehended.

P. And after the same Manner, while the Earth performs its annual Course, the Sun, which always seems to move the contrary Way, darkens, by his uncontrolable Splendor, the other Constellations successively: But still the Stars opposite to those thus intercepted, (between which, to wit, and the Sun, the Earth passes) become conspicuous to it from behind. Thus from beholding the Heavens in the Night Time, you may discover the relative Motion between the Sun and the Earth; and determine the real Motion of the Earth by the Arguments I have given you before.

M. All this I can imagine without Difficulty: The Stars must come in View successively on the Part of the Earth turned from the Sun, that is, in the Night Time, according as the Earth advances in its Orbit.

P. You are right; for after the Pleiades you will behold the glorious Constellation *Orion*, and the *Canicula* or *Procyon*, begin to shew themselves towards the South and East; and upon the North the *Twins*, *Castor* and *Pollux*. As the Year advances, the Constellations of

Leo

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Leo and *Hydra* begin to appear. And from the South *Sirius*, the brighteſt of all the Stars, ſhews himſelf blazing fiercely below the Equator; and far behind him, to the Eaſt, the *cæleſtial Virgin* with her *Spica*. Towards the End of Winter, *Arcturus* comes in View, while *Bootes* drives about his *Wain* from the North: At which Time you may perceive almoſt all the Stars of the greateſt Splendor at one View. For *Lyra* and the *Swan*, as alſo *Capella*, *Perſeus*, with the *Gorgon's Head*, and all that beautiful Region, either keep near the Vertex of the Sky, or dip but little under the Horizon.

M. O! what Pleaſure it gives me to hear theſe Things! I ſhall certainly endeavour to obſerve them with Diligence, till I am in ſome Meaſure acquainted with this pleaſant Subject.

P. They will make your Evening Walks agreeable; nor can you procure yourſelf a more refined and innocent Pleaſure: Not to mention how ſtupid it is to neglect ſuch Wonders in the Heavens, as if we were bowed down like the groveling Brutes.

M. Eſpecially when we make ſuch mighty Boaſt of having ſeen this or the other Lord's *fine Houſe*, or *Country-Seat*.

P. If we had a conſtant and uniform *Darkneſs* in the Ether a-Nights, *Matho*; if ſuch a Sight could only be ſeen by going to the Antipodes, or appeared but one Night in an Age, who would not crowd to the Place, or watch for the Time?

M. Men

M. Men would then *crowd*, and *watch*, out of an unmeaning Curiosity: But a rational Spectator is not satiated with beholding by Night, and meditating by Day.

P. It is so; knowing the *Uses* and *Ends* of what we behold can only make us put a just Value upon them; otherwise they cloy and satiate, as Baubles do an Infant.

XXXIX. *M.* In the mean Time, I think, I can collect something farther, from what you have said.

P. What is it?

M. Since the Sun appears thus always to move the contrary Way to the Earth; since he darkens by his Splendor that Part of the Heavens in which he is seen; and since the Point of the Heavens opposite to the Sun is that which is on our Meridian at Mid-night, as he is at Mid-day, we may know from looking at the Heavens themselves at that Hour, (Mid-night, to wit), both the Point of the Heavens in which our Earth is, as being then on our Meridian, and the Point in which the Sun then seems to be, as being directly opposite to the other.

P. You hit the Matter exactly. For if the first Degree of *Libra* (that I may speak of Names of which you have not yet heard) be on our Meridian at Mid-night, the Earth, to an Eye placed at the Sun, would appear to be in that Point; whence we know that the Sun is in the opposite Point, or in the first Degree

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Degree of *Aries*, which happens about the 9th of *March:* And thus they proceed, occupying ſtill oppoſite Points through all the following Signs of the *Zodiack.*

M. Though I am not quite a Stranger to theſe Names, yet pleaſe to make me better acquainted both with the *Names*, and the *Things* they ſignify.

P. That is but reaſonable.——This cœleſtial Globe, you know, repreſents, on its convex Surface, the concave Face of the Heavens. The great Circle here, which cuts the Equator obliquely, having one half of it raiſed to the North, and the other depreſſed towards the South, is called the *Ecliptick.* It is, indeed, the very Orbit of the Earth; but it ſeems to be, and is called the *Way of the Sun*, for a Reaſon already often mentioned; becauſe the Sun ſeems always to move in the oppoſite Point of the Earth's Orbit. It is divided into twelve equal Parts, which are called *Signs.* Theſe are known by the Names of certain living Creatures, which here you perceive painted in Order, *Aries*, *Taurus*, *Gemini*, *&c.*

M. I have obſerved the Names, and Pictures of the Creatures: But why is the Circle itſelf called the *Ecliptick?*

P. Becauſe the Eclipſes of the Sun and Moon happen in, or near it.

M. Does the Sun ever appear to move out of this Circle, which, you ſay, is called the *Way of the Sun?*

P. Never;

P. Never; but the Moon's Orbit cuts it at a small Angle, whence she moves always a little out of it, except in the Points of Intersection; the Consideration of which Matter is foreign to our present Purpose.

M. I have a Notion of the Eclipse of the Moon, that it happens by her passing through the Earth's Shadow, as you shewed me before.

P. Well; the Eclipse of the Sun is occasioned by the Interposition of the dark Body of the Moon, between *him* and us: And as the one happens in, or near the *Full*, so the other can only happen in the *Change* of the Moon.

M. I now, indeed, remember, I saw a notable Eclipse of the Sun some Time ago; and heard People talking much about it. A small Ring of the Sun's Body shone round the Moon; whence, I perceive, he must be at least larger than the Moon.

P. And that not a little, if you consider at what a vast Distance he is beyond our Satellite.

M. It must be so. I hope I shall soon have the Pleasure of understanding these Things better.

P. To return; you are chiefly to take Notice of four Points of the Ecliptick, because much depends on the Knowledge of these.

M. What are they?

P. The first of *Aries* and *Libra*, which are called the *Equinoctial Points*; because when the Sun, or rather the Earth, is in these, the Days and Nights are equal to all the Inhabitants of the Globe: And the first of *Cancer* and

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and *Capricorn*, which are called the *Solſtitial Points.*

M. I perceive the Points themſelves on the Globe, and think I know the Reaſon why the laſt are called *Solſtitial.*

P. The Reaſon is not hard to be found out.

M. Since the Sun in theſe Points of the Ecliptick is fartheſt diſtant from the Equator, either to the North or South, before he begins to return, he ſeems to ſtand a little, his Motion poſſibly appearing then ſlower.

P. It is ſo indeed. And from his turning back at theſe Points, thoſe two leſſer Circles, parallel to the Equator, are called *Tropicks*; for the Word ſignifies *turning back.* When he comes to the *Tropick of Cancer*, it is our Summer Solſtice; and we have then the longeſt Day, and the ſhorteſt Night: But when he is got down to the *Tropick of Capricorn*, or Winter Solſtice, our Days are ſhorteſt, and Nights longeſt.

M. It is but reaſonable, I perceive, that theſe Points ſhould be chiefly taken Notice of; ſince when the Sun is in theſe, (or rather the Earth, as you obſerved,) he either makes our Days and Nights equal, or gives one of them their greateſt Length; ſo that our moſt remarkable Changes begin from them.

P. The Obſervation is juſt. Laſtly, you perceive here the *Polar Circles*, as far diſtant from their reſpective Poles, as the Ecliptick declines from the Equator, which Diſtance you may yourſelf meaſure on the brazen Meridian.

M. It

M. It seems to be about twenty-three Degrees. The third Conference.

P. And almost an half.

XL. *M.* Thus far, I think, I understand: But how are we to find out in the Heavens themselves those Signs of the Zodiack, where certainly there are no Effigies of the Creatures, whose Names the Signs bear, as on this painted Globe?

P. The *four Points* we have been speaking of are known and determined by astronomical Observations; and the Degrees are reckoned from the first of *Aries* eastward, or through the *following Signs* (as they used to speak) in every Sign thirty Degrees. Hence the Signs themselves are known and limited; since each of them takes up the twelfth Part of the Ecliptick. And thus it is known what Stars are contained within such a Space, so that they can be reduced to their proper Sign, and the Degree of that Sign: And when once a few are known, we come to the Knowledge of the rest without much Difficulty. As for Example, the *Pleiades* we spoke of are in the twenty sixth Degree of *Aries*, and four Degrees distant from the Ecliptick northward. From these you will easily discover both the *Names* and *Places* of the nearest Stars, and from these again others; remembering always to make yourself acquainted with the Stars of the greatest Magnitude first, for these will direct you best.

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beſt. And thus you may make a *Map* as it were of this Part of the Heaven.

M. To that Purpoſe this *artificial Globe*, I preſume, will be of Uſe.

P. Of very great Uſe: For on it you have the Names and Places of the Stars marked according to the lateſt Obſervations.

M. And the *Heavens* and *Globe* are to be conſulted by turns.

P. That will be proper: Only you muſt firſt underſtand ſo to ſet, or rectify the Poſition of the Globe, that it may repreſent the Face of the Heavens at any particular Time. You will alſo eaſily ſee that the Winter Time, and the long and clear Nights, are fitteſt for this Purpoſe: You may then have the Proſpect of the whole Converſion of the Heavens almoſt in one Night. But a Friend will ſhew you more in two or three Evenings, than you could otherwiſe find out by yourſelf in a long Time. After that, a little Practice will make the Thing both eaſy and agreeable. That Seaſon will always return with Pleaſure to you: Every Year will renew your former Acquaintance: You will have a chearful Temper, and find rational Entertainment, while others are eaten up with the Spleen and Vapours.

M. I ſhall long exceedingly for that Seaſon.

P. You will find it more difficult to obſerve the Stars when near the Horizon, than when they are got higher up; for the Air is more groſs and thick, while we direct our View along

along the Surface of the Earth. And for the same Reason, Stars not far distant from each other, when near their greatest Altitude, seem farther separated while they rise in the East, or go down on the other Side; which you will observe at first, not without some Surprize. The third Conference.

M. I have, indeed, observed a *Tree*, or a *Man*, to appear taller and larger, seen through a foggy Air, than when it was perfectly clear.

P. Even when the Air is clearest, it is still thicker near the Earth, because of the Vapours constantly rising: And when you look at an Object on the Horizon, the Eye encounters more of this Thickness, than by looking higher upward.

M. Possibly, it is this Thickness of the Air near the Earth, that makes distant Mountains appear blueish; and, if a great Way off, scarce distinguishable from the *blue Ether*.

P. It is very well observed, *Matho*; and this shews us that the *Atmosphere* becomes purer and finer, the higher it rises. If it were as gross for forty or fifty Miles straight upward, as for an equal Distance outward, or near the Surface of the Ground, we should neither enjoy the Light of the heavenly Bodies so pure, nor the Heat of the Sun to such a Degree, as at present. The Sun would often appear coloured, with his Edges well defined, the Strength of his Rays being taken off, as sometimes he appears now when near the Setting.

M. I am glad of having stumbled on the Observation: What you say satisfies me, that

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the higher Air becomes ſtill more clear and tranſparent: It muſt have been very uncomfortable, if our Heat and Light had been thus greatly abated. And from this, I think, we may infer, that the Altitude of the Atmoſphere cannot be very great.

P. Indeed, *Matho*, that is uncertain. The Air is a *ſpringy*, or *elaſtick* Fluid: The upper Parts of it, therefore, muſt be at ſuch Diſtance from the Earth, that their Gravitation to it, and Repulſe from the lower Particles, may be *in Equilibrio*. Their Attraction to the Earth can *there* be but very ſmall, and their repelling Force is exceeding great.

M. Leaving that Affair then; in turning round the Globe here, I perceive the ſeveral Signs do not keep within their own Limits.

P. There are ſome Niceties obſerved about the Equinoctial Points, which is not worth your while to dwell upon at firſt.

XLI. *M.* Things then being, I preſume, rightly prepared, pray ſhew me how the great Changes in Nature, and the Diverſity of Seaſons are brought about by the annual Motion of the Earth.

P. In Order to this you muſt imagine yourſelf in good Earneſt to be carried round the Sun, with the Earth, for one whole Revolution.

M. Since you have ſhewed me that we are thus conſtantly carried round him, it is only imagining a real Matter of Fact, drawn into a narrower Compaſs.

P. It

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P. It will be proper to begin from the first Degree of *Libra*: for the Earth being there, the Sun must appear in the first Degree of *Aries*; and you may fancy that this is the ninth of *March*, or vernal Equinox.

M. Let us set out then.

P. Call to Mind, likewise, that the Axis of the Earth points constantly to the Pole of the Heaven; that *Point*, namely, which seems immoveable in the Earth's diurnal Revolution: For by this Means it happens (because of the immense Distance of the Heavens) that the Axis keeps still parallel to itself.

M. This I do not understand; pray explain it a little.

P. I imagine a Diameter drawn through the Earth's Orbit, from North to South, or from the first of *Cancer* to the first of *Capricorn*: And if the Earth's Axis was produced, when it is in the Extremities of that Diameter, the two *Productions* would meet in the Pole of the Heavens, and with that Diameter form a Triangle: And yet the Axis in both these Positions seems exactly parallel to itself.

M. When its Productions make the two Sides of a Triangle?

P. Even in that Case.

M. This I cannot comprehend, unless I should suppose these two Sides immensely long, and the Diameter of the Earth's Orbit extremely short, with Respect to either of them, or like a Point between them.

P. That is indeed the very Case.

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M. Then it seems the whole Diameter of the Earth's Orbit is as little, with Respect to the Distance of the Heavens, as the Semi-diameter of the Earth is, with Respect to the Distance of the Sun.

P. It is so.

M. This is amazing! We can scarce form a right Notion of the Distance of the Sun, which yet is but as a Point in Comparison to the other. At that Rate the whole planetary System must be but a small Thing, compared with the stupendous Concave of the fixt Stars.

P. Less than a *Nut-shell*, compared with some *spacious Dome*.

M. I must remember this, and think of it more at Leisure.——

P. Here likewise is an easy, intelligible Figure of the whole annual Revolution, which will somewhat help your Imagination.

M. I perceive there *Aries* on our Right-hand, and *Libra*, whence we are to set out, on our Left: And I fancy we are to move according to the Order of the Signs, or towards *Capricorn*.——

P. Lastly, remember, that the Earth rolls round on its Axis, or performs the diurnal Revolution, all the Time it is carried round the Sun. For if that larger Globe represented the Sun, and this *small one* the Earth, it is as if I carried the little one round the bigger, and at the same time turned it on its Axis.

M. I understand: But all these various Admonitions put me in Mind of *Phœbus*'s tedious Advices

Advices to his Son, before he would permit him to mount the Chariot. The third Conference.

P. We are just going to start. But first, observe how Things are, in the Position the Earth is in at present: For, because the Equator of the Earth is now exactly opposed to the Sun, and he enlightens always a *Hemisphere*, or half of its Surface, his Rays will reach to both Poles. Whence from the diurnal Revolution of the Earth, the Days and Nights are equal all over the Globe.

M. You told me before, it was so at both Equinoxes, and now I perceive the Reason of it; we are in the Rays of the Sun for one half the diurnal Revolution, and in the Shadow of the Earth, or Dark, for the other half.

P. It is so: Let us now set forward; and as we proceed daily with the Earth toward the South, through *Libra*, *Scorpio*, and *Sagittary*, to the Beginning of *Capricorn*, the Sun seems to rise above the Equator, and move to the North, through the opposite Signs *Aries*, *Taurus*, and *Gemini*, to the Beginning of *Cancer*.

M. Not so fast. ——— The Earth, you say, is now on the South Side of the Sun. Why?—because its Axis, always respecting the North-Pole of the Heavens, is now more turned to him: Therefore he must be on the North of the Earth.

P. So far you are right.

M. And this is the Reason why he seems to rise higher to us: For, since over our Heads is always *upward* to us, as the Axis (keeping parallel

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rallel to itself) turns us more to him, he appears to rise higher above us. And for the same Reason, the South-Pole turning from him, he seems to fall lower to them.

P. You conceive perfectly well what Effect the Parallelism of the Earth's Axis has. Now since the Sun began to rise through the northern Signs; that is, since the Earth began to be among the southern Signs, and so turned its North-Pole more to the Sun; his Rays fall short of the South-Pole, and reach beyond our North-Pole, and that daily more and more, as the Sun seems to rise higher. Whence it comes to pass (the Earth still continuing to roll on its Axis) that the Days grow always longer with us in the north Parts of the Earth, and shorter to those who live on the other Side the Equator.

M. I understand; for now it happens that on this Side of it, the greatest Part of the diurnal Revolution is performed in the Light of the Sun; but on the other Side, the greatest Part is performed in the Shadow of the Earth. Whence I suppose their Nights must grow equally long with our Days, and their Days grow short with our Nights.

P. It is, indeed, exactly so.——When the Sun has at length reached the Beginning of *Cancer*, and we are come to the first of *Capricorn*; that is, when he seems to have got to the northmost Point, and we are really in the southmost Point of the Earth's Orbit, our Days are at the longest, and theirs on the other Side the Equator are at the shortest. *M.* And

M. And how far do the Sun's Rays reach then beyond the North-Pole?

P. Just as far as he seems to have risen above the Equator; that is, to the farther Side of the Arctick Circle; and, on the opposite Part, they reach only to the nearer Side of the Antarctick Circle. Whence the first is all in the Light, and the last all in the Earth's Shadow.

M. I should have perceived this, without asking you the Question. For since he always illuminates a Hemisphere, or half of the Earth's Surface, he must shine as far beyond the one Pole, as he has advanced nearer it; and as far short of the other, as he has receded from it.

P. And now we are at the Tenth of *June*; for the Earth has performed in the interim about ninety-three Revolutions on its own Axis.

M. Thus far, I think, I conceive perfectly.

P. And now, *Matho*, that we are on the southmost Point of the Earth's Orbit, let us imagine that we observe the *Altitude* of the Pole, and mark it down.

M. To what Purpose?

P. You will see immediately.

XLII. Having thus travelled with the Earth through the first Quadrant of the Ecliptick; from the Tropick of *Capricorn*, we begin to move eastward, through *Aquarius*, and *Pisces*, to the first of *Aries*; and the Sun the contrary Way, from the Tropick of *Cancer*, through *Leo*, and *Virgo*, to the first of *Libra*.

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M. Let me, if you pleaſe, conſider the Earth's Motion in this Quadrant. ——Its Axis always reſpecting the North, or keeping parallel to itſelf; and the Sun ſeeming to move weſtward, as we advance Eaſtward; the Inclination of the Axis northward will gradually ceaſe to be turned to him: So he muſt loſe of his Altitude, or ſeem to deſcend to the Equator again, by the ſame Degrees as he ſeemed to riſe above it in the former Quadrant.

P. You expreſs the Appearances with much Propriety. And as to the Length of the Days and Nights? ——

M. The Days muſt be ſhortened from the Solſtice to the autumnal Equinox, in the ſame manner as they were lengthened from the vernal Equinox to the Solſtice: For it is eaſily ſeen that the Sun muſt enlighten the Earth in the ſame manner when he returns to the Equator, as when he departed from it.

P. Becauſe in equal Diſtances from the Solſtice the Earth's Axis is equally inclined to the Sun; ſo that its Motion through this Quadrant is only the Converſe of its Motion in the laſt.

M. That makes it ſo eaſy to be apprehended: The only Difficulty is to conceive it in the firſt Quadrant. And now that we are come to the firſt of *Aries*, the Days and Nights muſt be equal again; as when we ſet out from the firſt of *Libra*.

P. One Particular here however is worth your Notice.

M. What

M. What is it?

P. The Arctick Pole hath been in the Light of the Sun, all the Time from the vernal to the autumnal Equinox; that is, all the Time the Sun hath been among the six Northern Signs.

M. This is abundantly obvious: For as soon as the Earth moved by the first of *Libra*, his Rays reached beyond the Pole; nor have they yet left it, when we are got to the Beginning of *Aries*.

P. And the South Pole hath been all the Time in the dark.

M. That is equally plain: But the Sun will make up its Losses when he is among the Southern Signs.

P. He will indeed.

M. And hence it follows that at the Poles of the Earth, there is but one Day and one Night in the whole Year.

P. You are so ready in these Things, *Matho*, that I think we need go no farther in the annual Revolution.

M. By all Means finish the Earth's Course.—

P. We leave the first of *Aries* then on the 12th of *September*, and the Earth begins to move North from the Sun: Our Pole now is turned gradually away from him, because of the constant Inclination of the Axis northward, and the South Pole is turned more to him. Whence he seems to fall down below the Equator to us, and to rise higher to those on the other Side of it; for over their Heads is *upward* to them likewise. In this Quadrant the

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the Night is lengthened the ſame Way, as the Day was from the oppoſite Equinox, till the Sun arrives at the Beginning of *Capricorn*, by our being carried to the firſt of *Cancer*, which is on the 11th of *December*. And then our Night is become as long as our Day was in the oppoſite Solſtice; and the Day as ſhort as the Night was then.

M. What a beautiful Regularity there is in all this Motion!

P. Being now come to the Northmoſt Point of the Earth's Orbit, let us obſerve the Altitude of the Pole again; and we ſhall not find it raiſed any higher, than in the oppoſite Point; though we have been carried towards it by the whole Length of a Diameter of the *Magnus Orbis*.

M. I ſhall ſurely remember the Obſervation: By it I ſee clearly that *that Diameter*, how long ſoever, is but as a Point compared with the Diſtance of the fixt Stars.——

P. In this Situation of our Globe, Nature ſeems to lour upon us; and we ſuffer in our Turn the Rigours of the hard Seaſon. Our Rivers are frozen over, and the Earth is covered with deep Snow: While on the other Side the Equator Summer reigns, and the wearied Inhabitants ſeek the Shade to ſkreen them from the ſcorching Heat of the Noon-Day Sun.

M. By the ſame wonderful Motion of our Globe, I ſee the Bounty and Smiles of Nature reach all its Inhabitants!

P. From

P. From this chill Solstice we begin to move South, and the Sun seems to return northward; till the Earth, coming again to the first of *Libra*, finishes its annual Course, having in the mean Time performed about 365 Revolutions on its Axis, and thereby divided the Year into as many Days.

XLIII. Now, *Philon*, you have made me Master of the Thing I so much desired. The Earth's Motion from South to North of the Sun, with the Parallelism of its Axis, are as pleasant as new to me. Nothing could have given me a clearer View of this *grand Revolution*, unless I had been taken up into the Heavens, and beheld the whole annual Course from some convenient *Station* on high.

P. You are to make the *same Tour* then by yourself, I suppose, since you are so mightily pleased with the Speculation.

M. Not once, I assure you, nor confined to these *little Draughts* on Paper; but under the open Heaven, where I shall have Scope. And at no Time of the Year can I thus go round the Zodiack, but I must come to the Place where we then really are. There I will stop, and consider the Face of Things in that Position of our Globe; and by doing this frequently, the Heavens themselves will at length become my *Diagram*.

P. This will be an agreeable enough *Pass-Time*, *Matho*, when you happen to be cloy'd with your other Diversions, as you own'd was the Case sometimes. *M.* I

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M. I have even been ſometimes ſick of myſelf, *Philon*, having nothing to do that I could take a Pleaſure in: And if that be the *Spleen* or *Vapours* you ſpeak of, it is a bad enough Diſeaſe.

P. So much the worſe, as it beſpeaks a weak and feeble Mind.

M. I am obliged to you for teaching me how to prevent it.—But tell me, what would the Face of Things be, if the Equator and Ecliptick coincided into one?

P. You have already found out Things more difficult than this: Wherefore imagine your Suppoſition to be Reality, and then try to anſwer your own Queſtion.

M. My Lazineſs deſerves a ſeverer Reproof: Pray obſerve then if I can repreſent the Conſequences of ſuch a Caſe juſtly.——The Sun would be conſtantly on the Equator: Therefore there would be a conſtant Equinox, or Equality of Night and Day, all the Earth over: In the ſame Place there could be no Diverſity of Seaſons, becauſe the Sun would ſtill be at the ſame Diſtance from them: And laſtly, we might diſcover the *Limits of the Year*, that is, the End of a Revolution of the Earth round the Sun, by the Stars ſeen in the Night Time, on the Side of the Earth turned from the Sun; but not eaſily by his apparent Motion by Day. And indeed in that Caſe the annual Motion of the Earth round the Sun, would be, I think, almoſt needleſs; ſince we ſhould have the ſame Degree of Heat and Light from him, if the Earth ſtood ſtill in the ſame Part, and revolved

ved on its Axis, as at present: Only we could then have but one Face of the Heavens, and the same Stars constantly exposed to our View in the Night Time: Which (if you would not think me a little vain) I own I should be sorry for: And I am sure the contemplative Part of Mankind would reckon it a prodigious Loss. The third Conference.

P. You have deduced the Consequences very justly, *Matho:* But what should we gain or lose by this Change of Constitution?

M. We should lose, I think, a great deal. At the Equator and neighbouring Parts all Things would be violently scorched with the Sun constantly over their Heads: In these Parts where we live, it is to be doubted if we could have any Grain, any Harvest, or Ripeness of Vegetables, having never more Heat than now about the middle of *March:* Elsewhere, eternal Winter, without the Hopes of a returning Spring, would banish Mankind from a great Part of the habitable Globe. And certainly it is wonderful that from such a small Obliquity of the Ecliptick, so many agreeable Vicissitudes, and such Advantages to mankind should arise!

P. Your Reflection is well grounded; and so it is for the most Part; we do not attend to the Advantages of our present Constitution, till we consider fairly the Consequences that would ensue on a Change.——

M. But what are we to think of the other Planets? Do they enjoy the same Vicissitudes?

P. The

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P. The ſame, or at leaſt not much different: They are dark Bodies like our Earth; have a diurnal Rotation on their own Axes; and are like our Earth, carried round the Sun. Theſe *like Circumſtances* muſt produce the ſame Changes *in Kind*, though perhaps not the ſame *in Degree*. In *Jupiter* and *Mars*, the Ecliptick nearly coincides with the Equator: In *Saturn* theſe two Circles decline farther from each other, than on our Earth. Whence the firſt two Planets have a leſs Difference of Summer and Winter than what we enjoy; but the laſt a greater. And on what Account ſoever we may ſuppoſe a diurnal Revolution to be given to *Jupiter* and *Mars*, there will be ſtill greater Reaſon for allowing it in *Saturn*; if it be at all proper to ſpeak of the Equator of a Planet without ſuch a Revolution.

M. But how ſhould one know theſe Planets from other Stars, ſince they do not keep the ſame Place, but move, as our Earth does, through the conſequent Signs of the Zodiack?

P. That very Circumſtance makes it eaſy to know them. For on a very little Acquaintance with the Heavens, you will be ſurpriſed to find a great Star in any Part of them, which uſes not to be there. You will ſoon become acquainted with their Courſes and Periods, and know in what Part of the Heavens they ought to be found. And if you would have more Exactneſs, you may have recourſe to the aſtronomical Tables: It will give you the greateſt Pleaſure to be able to calculate before

fore hand, where they must be at any given Time.

M. You double my Curiosity, by flattering my Hopes so agreeably.——But as we have gone through a good many different Subjects in this Conference; if you please I would retire, and try to recollect them, while they are yet fresh in my Memory.

P. I am satisfied, and wish you good Success, *Matho:* These Subjects are but dry and un-entertaining.

M. If I can make them plain to myself, that will make them pleasant. Besides, I think you artfully decried the Description of the annual Motion, that I might be the more surprised with the Agreeableness and Variety of the Things represented.

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From the Conſideration of the Beauty *and* Order *of the Planetary Syſtem* Matho *is led to enquire how it began at firſt to be; or who was the* Author *of ſuch a Work? The Reaſons are laid down, by which this may be diſcovered. That the Planets are conſtantly impelled by two diſtinct Forces, without which they could not revolve in Orbits about the Sun: That any Body of itſelf reſiſts to revolve about a Center: That* Gravitation, *and the* Attraction *of* Coheſion, *cannot be the Effects of Matter, or any mechanical Cauſe ſhewn from Variety of Arguments. Hence* Matho *diſcovers that theſe Effects muſt proceed from the immediate Power of the Deity. The* Unity *and* abſolute Perfections *of the Supreme Being deduced in a plain and natural Way.*

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XLIV. *P.* SHALL I congratulate *Matho* on his ſafe Return from the ſtarry Regions?

M. You may, if you pleaſe, though I found every Thing ſafe and agreeable there. The *Bull*, the *Scorpion*, the cœleſtial *Archer*, and all the poetical Monſters diſappeared: My only Solicitude was, to conceive rightly the annual and diurnal Motions of the Earth, and

and how these occasion the Vicissitudes we observe in Nature. This I in some Sort accomplished: But now an Affair of greater Moment takes up my Thoughts. The fourth Conference.

P. What may that be?

M. When I consider attentively this *vast Frame* of the Planets, so simple in its order, and yet find that this Simplicity is the Source of such Variety, I am perfectly astonished. Wherefore let me ask you, how such a Frame began at first to be; or by what Force these *prodigious Bodies* are thus constantly driven round the Sun, and detained in their Orbits? I find I cannot be easy till I know the Cause and Origin of these Motions.

P. You may ask what you please, *Matho*; but I am resolved to answer in my own Way.

M. What is the Meaning of this, *Philon!*

P. The Meaning of it is, that I am not willing to disappoint you by a plain and ready Answer.

M. That Meaning is above my Comprehension.

P. The Case stands thus; a Question of such Importance is not to be answered in a Word, like *Facts*, for which no other Reason can be given, but that they so happen: Here we must proceed at Leisure, that the Truth may rather appear from the Reasons on which it is founded, than be delivered in bare Words, as when a School-master teaches a Child.

M. I remember you told me something like this before, and it is certainly a right Method:

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But as it is a long Time ſince you firſt ſaid ſo, pleaſe to tell me now more fully the Reaſons that lead to the true Anſwer of this Queſtion.

P. Even that I am not diſpoſed to do.

M. Then I perceive I can expect but little Satisfaction in a Point, which you yourſelf own to be of the greateſt Importance.

P. You are to proceed thus, *Matho*; tell me frankly what common Senſe ſuggeſts to you concerning the Motions of theſe heavenly Bodies: I ſhall ſurely oppoſe you Tooth and Nail; but do you maintain your own Side of the Queſtion, as far as Reaſon can ſupport you.

M. This is a very unequal Match, and not a great deal to your Credit, I think.

P. The Match, I'm afraid, is not ſo unequal as it would be: However, it will be of ſome Advantage to me, to hear the Sentiments of plain and unbiaſſed Nature, on ſuch a Subject. For it is here, as in Life, we Men live according to the Mode, and argue from Authority: So that though I loſe in the main, I ſhall gain in hearing your natural Sentiments.

M. Without replying to theſe Flouriſhes, I think ſome mighty Force muſt be neceſſary, to put thoſe huge Bodies once in Motion; and then they ſtand in need of a conſtant Direction, otherwiſe they would every Minute leave their Orbits; ſince no Body of itſelf can revolve about another in a free Space.

P. What ſhould hinder it?

M. What ſhould hinder it!——Is it neceſſary that it ſhould of itſelf ſo revolve in a free Space?

P. I do not say it is.

M. It is your Business then, I think, rather to shew me what should cause it, than mine to shew you what should hinder it. For if there be no Cause to produce the Effect, though there be nothing to hinder it, the Effect can never be produced: Nor can there be a greater Impediment to any Thing, than the Want of a Cause to produce it.

P. It may be so.

M. Nay, it cannot be otherwise. I perceive, *Philon*, you are endeavouring to puzzle me; but I can maintain this against you, or any Body else. Besides, I know from a hundred different Instances in my Diversions, that if I strike a Ball, or any such Thing, it goes straight forward, but never moves in a Circle. I remember nothing that moves in a Circle, except when we drive a Stone round in a Sling; or perhaps when some light Body is carried round in a *Whirl* of Water; which certainly is not applicable to the Planets describing circular Orbits in free Spaces.

P. How do you know that the Spaces in which the Planets move are free? They may be full of a subtile Matter.

M. Look you, *Philon*, I am yet but a raw Disputant, and know not all your Arts of disconcerting People; nor shall I ever study them, since I think they only obstruct the Discovery of Truth: But this I know from Experience, that our Earth, for Instance, is surrounded with no such dense Matter, as could keep it

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within the Limits of its Orbit, which it must endeavour constantly to break through, by its rapid Motion *. Besides, supposing that some such impalpable Stuff, as this subtile Matter of yours, could drive the Planets round, what, I pray you, must drive this Matter round, and every Particle of it? This increases the Difficulty. And if you should say that this Matter does not move round with the Planet, but stands still, it must, by its Resistance, stop the Motion of the revolving Body, instead of keeping it within its Orbit; which increases the Difficulty another Way. Nor have I forgot, when I say this, what you told me concerning the Atmosphere's surrounding the Earth: But it reaches to no great Height, and partakes as well of the Earth's annual, as diurnal Motion. And its annual Motion remains to be accounted for, as much as the Earth's; since its diurnal Motion could not be otherwise accounted for, than the Earth's was.

P. These are the Things, *Matho*, which I was desirous of hearing from yourself. You are sooner and more strongly convinced, by entering into the Discussion of Particulars, and discovering the Reasons of them yourself, than you could have been by hearing the same Things from me: And as this is the most effectual, so it is by far the shortest Method.

* *Corpora, quæ in vortice delata in orbem redeunt, ejusdem sunt densitatis cum vortice, & eadem lege cum ipsius partibus quoad velocitatem & cursus determinationem moventur.* Prop. 53. Lib. 2. Princip. D. Newton.

M. Tell

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M. Tell me then by *what Force*, or the *Direction* of what Cause, the Planets thus continue to move round the Sun in circular Orbits?

P. By no Force, and the Direction of no Cause at all.

M. And yet I have shewn you just now, that a Body must go straight forward, and cannot move in a Circle, unless it be constantly kept in, as a Stone is by the Sling.

P. But pray take Care, lest your Diversions deceive you in this Point.

M. Which Way?

P. When you throw a Stone straight forward, it doth not move straight forward; but always draws nearer the Earth, and at last falls on it.

M. It is so, indeed. But hold a little.—— This is excellent! How oft have you told me, that the Action of *falling downward*, is not the Action of the Body itself which falls, but the Effect of another Cause? This is what I am contending for, and your Instance to the contrary makes against yourself.

P. I see you are flusht with Success, *Matho:* But leaving this Instance as we found it, What would you say, if I should deny that there was any Cause that kept the Stone to a circular Motion, while it is whirled round in the Sling?

M. If you denied such a Cause in good Earnest, I could easily convince you, provided you could be convinced by Reason.

P. Convince me if you can.

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XLV. *M.* I ſhall not ſtay then to obſerve that you ſeem to deny this *Fact* in a very contradictory Manner; but aſk you, if a Stone put into a Sling could move in any Manner without *ſome Hand?*

P. It could not.

M. And then, could it move round in a circular Space, if the Sling did not conſtantly keep it within thoſe Bounds?

P. I cannot tell.

M. Come, ſpeak ingenuouſly, *Philon:* I undertook only to convince you, provided you would ſtand to Reaſon.——For tell me what happens, if you let the String go?

P. The Stone immediately flies out.

M. Doth not, therefore, the String conſtantly impreſs *another Force* upon the Stone, in drawing it ſtill back to the Hand, as it were the *Center* of its Motion?

P. I own it does.

M. The Stone then is conſtantly preſſed, or urged by *two contrary Forces:* By the *one*, it would inceſſantly fly out, this belongs to the Stone itſelf; and by the *other* it is as inceſſantly kept in, this is the Action of the String. Have you any Thing to reply to this?

P. Nothing.

M. There is another Conſideration, likewiſe, that confirms all this, and in which any Boy would be able to give you Satisfaction.

P. Pray let me hear it.

M. If

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M. If we whirl round the Stone with more Velocity, it sometimes happens that the String breaks; which shews, that as the circular Motion becomes swifter, the *centrifugal Force* (as I now remember you called it before, when speaking of the Ring twirled round on the Table) becomes stronger.

P. It does certainly, otherwise the String would not break.

M. And must not this Increase of centrifugal Force require an equal Increase of contrary Force to keep the Stone to its Orbit?

P. It must.——And now, *Matho*, you have convinced me sufficiently; but at the same Time you have taught me how I may convince you, if you should deny again any of these Things, you have just now affirmed.

M. That I shall be very far from doing: But pray what do you mean by such an Insinuation?

P. I say, that this our Earth, and every one of the Planets, is constantly urged or impelled by two contrary Forces; *one* which always drives the Planet straight forward, and *another* which keeps it constantly from running out, by retracting it towards the Sun, the *Center* of its Motion. What do you think of this?

M. I think it is easier to affirm than to prove it.

P. What do you deny in it?——Well, since you seem in Doubt what to deny, tell me, Would the Earth placed at this Distance from the Sun move any Way without *some Hand*;

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that is, without a Force impreſſed upon it by *ſome Cauſe?*

M. It would certainly remain there for ever.

P. Would it begin to move forward, think you, or backward? upward or downward?

M. I own it could move no Way, more than the Stone in the Sling.

P. Some HAND, therefore, (whatever that may be) impreſſes *one Force* upon the Earth.

M. I own it.

P. But if only one Force were impreſſed upon it, driving it ſtraight forward, what would happen? Would it keep to a circular Orbit, if another Force did not conſtantly draw it towards the Center?

M. It could not of itſelf keep to a circular Orbit, more than the Stone.

P. For if no other Force acted, what would enſue?

M. It would undoubtedly begin to leave its Orbit that Inſtant.

P. Does not, therefore, ſome HAND inceſſantly impreſs a *ſecond Force*, to prevent——

M. It is enough, *Philon*; I always forget to make the Application from common Inſtances, where our own Experience is Judge, to other Caſes leſs attended to; though the ſame Reaſons are applicable to both: But now I ſee there is an equal Neceſſity for the conſtant Impreſſion of both Forces, as well in the Revolution of ſuch vaſt Bodies as our Earth, as in this ordinary Experiment. And indeed, this is the Notion I myſelf had at firſt; though

I did

I did not perceive the two different Forces so distinctly, nor was I so much satisfied about the reality of them. The fourth Conference.

P. For can a Body, the greater it is, require less Force to give it any Sort of Motion?

M. It requires a greater, surely, and that in Proportion to its Magnitude.

P. Since then a Stone twice as big would require double Force, and one thrice as big triple Force, and so on; consider with yourself, how great that Force must be, which drives round, and keeps to a circular Motion, such a Body as the Earth, loaded with such vast Mountains, and prodigious Rocks, and flying with such Rapidity.

M. Such Force is above our Estimation, because we know nothing can be compared with it. Yet I should have somewhat a juster Notion of it, if I knew what the Earth's Velocity in its Orbit were.

P. It would be an easy Matter to shew you that, if we were certain of its true Distance from the Sun. But, as I have said before, that Distance is hitherto undetermined.

M. However, satisfy my Curiosity so far, as to tell me its Velocity, on the common Supposition?

P. If the middle Distance of the Earth from the Sun be two thousand of its own Semidiameters, its mean Motion in its annual Orbit is nine hundred and fifty-three *English* Miles in a Minute: But if its Distance be twenty-one thousand of those Semidiameters

(which

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(which comes nearer the general Suppoſition) in a Minute of Time it flies full a thouſand Miles.

M. This raiſes my Aſtoniſhment above Expreſſion. If I conſider a prodigious Body, near eight thouſand Miles in Diameter, ſhooting through the Ether at the Rate of ſixty thouſand Miles in an Hour, and that we ourſelves are carried along with it.——But is this to be depended upon?

P. If that be the true Diſtance of the Earth from the Sun (and ſome have made the Diſtance between them much greater) this Velocity of it is as certain, as it is that it moves at all.

M. This looks like the Exaggerations I have heard of in ſome of the *Mahometan* Legends.

P. Thoſe Legends, *Matho*, are only the Productions of an ignorant and irregular Fancy: But alas! the moſt unbounded Fancy is narrow, in Reſpect of the Power of that Cauſe, which we have now under Conſideration.

M. I ſhall not be able, for ſome Time, to get over the Amazement this Particular has thrown me into.

XLVI. *P.* It is proper, before you go farther, to let you know, that the one of theſe Forces, which prevents the Planets from running out in ſtraight Lines, by drawing them conſtantly inward to the Center of their Motion, is called by Philoſophers the *centripetal Force*; and the other, by which they would run out, is called the *excurſory* or *projectile Force*.

M. Theſe

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M. These Names express the Difference of the two Forces very clearly.

P. As to the Observation which you Boys make, that when you whirl the Stone about with more Velocity, its centrifugal Force becomes the greater, it is very much to the Purpose: For, as you rightly observe, the centripetal Force (or the stretching of the String to keep it in) is increased equally. Therefore knowing the Quantity (or Strength) of one of these Forces, you must always know the other; and you will find the Increase of the centrifugal Force very regular, according to the Increase of Velocity; which may be of great Use to you hereafter.

M. I little thought our Diversions could have been so useful to us in these Matters.

P. As it is of Consequence to you to be familiarly acquainted with the Necessity for these Forces, pray answer me a few Questions.

M. Ask what you have a Mind.

P. If neither of these two Forces were impressed upon a Planet, what would follow?

M. Nothing; for the Planet would rest in the same Place, as much as the Stone did in the Sling, when no Hand moved it.

P. If the centripetal Force were only impressed, what then would be the Consequence?

M. The Planet would straightway be drawn down towards the Sun.

P. If only the projectile Force acted?

M. It would run out through the cœlestial Regions, without Let or Hindrance.

P. If

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P. If ſome HAND ſhould impreſs both Forces together, ſo that neither of them could overcome the other, what would be the Effect?

M. The Planet could neither draw nearer the Sun, being hindered by the excurſory Tendency; nor run out to a greater Diſtance from him, being kept in by the centripetal Impreſſion; but muſt neceſſarily revolve in a Circle.

P. But perhaps it is not neceſſary that both Forces ſhould act upon the Planet inceſſantly, and every Moment?

M. It is as neceſſary here as in the Experiment of the Sling: For in the inſtant either of theſe Forces ceaſed to act, one of the two Conſequences juſt now mentioned would follow. Our Earth, for Inſtance, would either be drawn down towards the Sun, or fly out through the cœleſtial Spaces.

P. You ſee then of what Difficulty it is, and what Force it conſtantly requires, to make a Body revolve about a Center in a free Space.

M. I ſee this ſo clearly, that (if the Body be a Planet) I have not Words to expreſs how difficult and wonderful an Effect it is, and what the Force muſt be; ſince any little Pebble, driven round a Center, requires the conſtant Action of an *external Cauſe*, and that acting in two very different Manners. But the more difficult this Effect is, ſo much the more impatient am I to know the Origin of ſuch Force, ſo juſtly applied: I beg therefore you would not keep me any longer in Suſpence.

P. Why

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P. Why should you still urge this Question so prepostorously, and so wide of the Purpose? From the very Beginning you must know the Cause of *Gravity* at all Events: Now you are solicitous to know *what Cause* so constantly impresses this Force on the Planets. You see a prodigious Force is necessary; you see this prodigious Force is supplied, and justly impressed for attaining the End: And is it not very happy for us that Things are so? That *Power* and *Force* are not wanting in Nature, to our comfortable subsisting; though we should neither know *how* nor *whence* they are supplied?

M. Why did not you tell me from the Beginning then, *Are we not very happy that all Things are so as we see them, though we should know nothing farther about them?* There would be a Compend of Knowledge indeed, and an End of Enquiry! Have you not told me that nothing is so pleasant to the rational Nature as the Discovery of Truth; nothing more generous than to communicate Knowledge? Is it generous or fair, *Philon*, first to raise in me a rational Desire, and then to seem to envy me the Gratification of it?

P. That is not the Case, I can assure you, *Matho:* But since you are so importunate, we shall come to the *Cause* immediately; though the longer it had been delayed, it must have been discovered with the greater Certainty; for which Reason I was willing to put it off for some Time.

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M. As you have encouraged me to oppose and contradict you, you need not fear I should give my Assent till I were fully convinced of the Truth of what you advance.

P. To come to the Point then.

XLVII. Tell me, do you remember an Observation you made before, when we were speaking of the Figure of the cœlestial Bodies, from which you inferred that they were all spherical?

M. What was it?

P. It was that this Attraction, which obtains through the whole Mass of our Earth, and belongs to every Particle of it, is no less prevalent in all the other Bodies of the Universe.

M. I remember it very well, and am still of the same Mind, since that mutual Tendency, of all the Parts of any Body to each other, must naturally bring them into a spherical Figure. It is not enough that they come into Contact *any how*, so as to form an irregular Figure: They must still move to that Point where the stronger Force draws them; and thereby form, and tend to a Center. In Fluids this is very plain, let the Body be a hundred or a thousand Times as big as our Earth, as you then shewed me. And in this Case we must distinguish, I conceive, between the two Sorts of Attraction, that of *Gravitation*, and that of *Cohesion*. They are quite different Forces, and preserved distinct in their Effects, even when they tend the same Way, as you then

then likewise explained. It is thus the Particles of Iron, which tend to the Center of the Earth, adhere to other Particles of the Metal in the same Direction, by a different Sort of Force: The two Forces, you said, could not have been preserved more distinct, though the Particles had been large enough to admit of Pulleys and Engines to be fastened to them, and though they had been wrought by the most skilful Hands. In short, as Gravitation is a Tendency of every Particle of Matter, to be in Contact with every other possible Particle, this could never form a *tough*, a *hard*, or a *brittle* Body: Therefore it leaves Matter still in the least possible separate Particles, without any particular Degree of Cohesion between neighbouring Particles. It only regards the Figure of the whole Mass, and as it effects no particular Cohesion between Parts in Contact, it must necessarily produce Roundness of Figure in every Body great or small: And wherever it is otherwise, the Effect must be hindered by the different Degrees of Cohesion in particular Bodies; as you shewed me it was in the Mountains, which are supported by hard and unyielding Rocks, that they may keep to that Height so necessary to a habitable Globe.—— You likewise shewed me in the most convincing Manner, that the same Attraction of Gravitation is indispensibly necessary to preserve the great Bodies of the Universe in that spherical Figure. Without this, Water would not be Water, nor could fluid Bodies conform themselves

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ſelves to a globular Surface, as we ſee they conſtantly do. They might admit of, or remain in any Sort of Figure, how wild or irregular ſoever; or if any Force detached them, they might remain in the ambient Space, without ſeeking back again to their proper Center. Nay, all Matter might thus remain ſcattered and diſſipated in the wide Expanſe.——From theſe Conſiderations, this Attraction of Gravitation ſeems to me the only Power in Nature, adapted to form Matter into ſpherical Bodies; and the neceſſary *Cement*, without which they could not be preſerved in that Figure; and therefore we muſt ſuppoſe that it firſt obtained, and ſtill prevails, through all the Stars of Heaven, as well as between all the Particles of our Earth, or of the other planetary Bodies, which we know to be prodigious Spheres of Matter.

P. I find, *Matho*, you are not idle when abſent: You have greatly improved the ſlender Hints I gave you. Nothing can be more juſtly obſerved, than that the Attraction of Gravitation, ſince it is a Tendency of every Particle to be in Contact with every other poſſible Particle, can effect no particular Degree of Coheſion between the Particles in Contact. Hence this Attraction leaves, as you ſaid, the leaſt poſſible Parts of Matter looſe and ſeparate among themſelves, ſo as to move eaſily one upon another, provided their Diſtance with reſpect to the Center of their Tendency be not changed. We cannot conceive that from this, or from any other uniform Impreſ-

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sion on the Substance of Matter, there should arise a *Diversity*, or *Irregularity* of Figures among the Particles, to hinder their easy Motion, or sliding one upon another. *Irregularity of Figure* proceeds from different Degrees of Force, variously impressed (or different Degrees of Cohesion) in order to constitute different Sorts of Bodies. Thus this Attraction, as you rightly inferred, only regards the Figure of the whole Mass; and that, one uniform and regular Figure, to wit, the *spherical*: Whereas the other Sort of Attraction is consistent with any Sort of Figure, how irregular soever. And thus we may be satisfied that any Quantity of Matter in these Circumstances, (that is, the most fluid possible) must form one great Body perfectly spherical. We must likewise conceive (according to the Order of Nature) that this Sort of Impression was first made upon Matter; and that the particular Attractions, which constitute the different Degrees of Cohesion, and form the various Species of Bodies, were superinduced upon it. It was certainly necessary, before the particular Sorts of Bodies could be formed out of the common Mass, that the Particles should all be brought to one Place. And accordingly all the Particles of the several different Kinds of Bodies which we know, were once in a fluid Form; the Bodies themselves therefore were formed out of Matter under these Circumstances.

M. This natural Deduction even assists the Imagination; and the Reasons assigned shew to

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Satisfaction, that this Attraction first formed (as I said before) and still preserves the spherical Figure of all the Stars in Heaven, as well as of all the Bodies in our Solar System.

P. I am glad you are so much Master of this Subject: You could not have recollected these Particulars, and reasoned upon them thus at a more proper Time; nor can any Thing be of more Service to you in the Enquiry we are upon at present. Wherefore tell me, *Matho*, do you think that this Attraction of Gravitation, by which these Bodies still preserve their spherical Figure, obtains or acts only within their Surfaces?

M. This Question, after what has been said, I should think, cannot be difficult: However, let me consider it, that I may be able to give such an Answer as may be satisfactory to us both.

XLVIII. Toward the Center of every great Body is *downward* with respect to it; from that Center is *upward*: This only happens because of the Attraction or Tendency to that Center from the ambient Space. It is certainly so round our Earth: The falling of Rain from the Clouds, and the Descent of heavy Bodies projected upward, plainly shew it. If Bodies thrown upward were not retracted, the Force of the Projection being spent, they would remain suspended on high: Or rather, if there were no Retraction, the Force of the Projection could never be spent. It must be so every where else, I conceive, otherwise Attraction could

could be of no Use to preserve the spherical Figure of those great Bodies: Any Part detached from them would remain for ever afterward separate. If these spherical Bodies were formed by Attraction at first, as we have just now seen they were, it must have been by the separate Particles tending to each other from all the surrounding Spaces. Why should not the same Attraction prevail still, or be able to act through all the same Spaces? Matter cannot be less *attracting Matter* now, than it was then. If there were any Quantity of Matter through the whole Solar System, which was attracted to no Center, it would remain there useless and unemploy'd. This shocks the Notion we have of the Order of Things. It might intercept the Light of the Sun and Stars, and make a Darkness and Confusion in our System. Such a World as ours requires Transparency and Clearness: Upon this our Comfort, our Heat and Light depend. How is Transparency effected? A small Quantity of Vapours, we find, obstructs it. Our Atmosphere is kept pure by the Repellency of its Parts; and yet, through all its Height, it is attracted to the Earth. — These, *Philon*, are the Thoughts which occur to me on this Subject, with Regard to the several Particulars we have discoursed upon before: And they seem to shew that Attraction acts all around, without the Surfaces of the great Bodies of Nature.

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P. You have touched upon some Things, *Matho*, of no small Consequence: Our At-

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moſphere is a Scene of peculiar Wonders. But leaving theſe, you are really of Opinion then, that there is no Space within the Solar Syſtem where Attraction to ſome Center does not prevail?

M. I am: For this Attraction does not (like the other) act in Contact only, but at vaſt Diſtances; of which we have certain Proofs.

P. What Proofs?

M. No Body can be ſo big, ſince all the Parts of Matter in it attract each other, but that many Particles muſt attract one another at the whole Diſtance of its Diameter.

P. But theſe extreme Particles may attract each other, by Means of the intermediate Particles.

M. Since Attraction between any two Particles is not, properly ſpeaking, the Effect of Matter at all, it cannot be the Effect of *intermediate Matter:* And the two Particles muſt affect each other the ſame Way, whether any other Particles lye between them, or not. At this Rate then, ſince, abſolutely ſpeaking, it is poſſible that a Body might be ſo big as to fill the whole Solar Syſtem, we ſee that two Particles of Matter muſt actually attract each other at all that Diſtance.

P. It is ſo indeed.

M. Therefore Attraction not only *may*, but *muſt* act through all that Space. If we ſuppoſe the contrary great Diſorders muſt enſue. If our Earth, for Inſtance, came to a Place where Attraction to no Center prevailed, it is hard to imagine what would be the Conſequence.

P. It

P. It would still attract Bodies to its own Center, even in such a Place. The fourth Conference.

M. That is true; but being thus deserted, it would remain there, like a Piece of useless Lumber: Or, if the projectile Force still acted, it must, at least, ramble out for ever through the Spaces on high.

P. What do you say, *Matho*; would the Earth be *deserted*, or at least, *ramble out for ever*, if it came to a Place where Attraction to no Center prevailed? Stop a little, and consider well the Consequences of what you are saying.—

M. This is an agreeable Surprize, *Philon!* You have brought me to maintain, without my knowing it, the Thing I chiefly wanted to be informed in. This Attraction of Gravitation acts indeed through the whole System, and is that *mighty Force*, which constantly impels the Earth, and all the Planets, towards the Sun, the Center of their Motion; and, together with their projectile Force, maintains their Revolution. It appears to me now so natural, that, if there were any Place throughout the System where Attraction did not obtain, that would be the Region of Disorder and Confusion. It is not only the Preservative of particular Bodies, but the Cement of the whole Planetary World, and I believe, of the whole Universe: For Confusion and Disorder of useless and unemploy'd Matter can reign no where in Nature. This likewise is that *centripetal Force*, I suppose, by which our Moon and the other secondary Planets are retained in their Orbits

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about their Primaries; there being Attraction to the Centers of thoſe *great Bodies*, as well as to that of the Sun.

P. That you may affirm without Heſitation: Every Thing is alike, you perceive, in both Caſes; to the Centers of theſe Planets is *downward*, from a conſiderable Space round them; and the ſecondary Planets obſerve the ſame beautiful Proportion in rolling about them, as they obſerve in rolling about the Sun himſelf.

M. That, namely, between the Squares of their periodical Times, and the Cubes of their Diſtances?

P. The ſame.

M. Well, *Philon*, when ſhall I underſtand this Proportion?

P. Not the ſooner for your Impatience.

M. That is true: However, I now perceive the other Reaſon *why the Sun was to be ſo large a Body*, with Reſpect to the reſt of the Planets; which you before kindly left to my own Diſcovery.

P. Namely?

M. Not only the Heat and Light of the Sun were to be diffuſed all around, as far as the Orbit of Saturn, but his attractive Force was vaſtly to exceed that of all the Planets, that he might not be drawn from the Center of the Syſtem. I am ſatisfied I ſhould not have had half the Pleaſure, if you had told me this, that I now have in finding it out myſelf.

P. For what muſt have happened, if one of the leaſt, inſtead of the greateſt Body, had

had been placed in the Center of the Syſtem? The fourth Conference.

M. It could not at all have been a Syſtem, if the central Body had not Force enough to reſiſt the Attraction of the other revolving Bodies; but muſt inſtantly have gone into Diſorder, and been carried through the cœleſtial Regions with endleſs Confuſion. It is as if we ſhould ſuppoſe a *Mill-Stone* to revolve about ſome *little Pebble*, and not the Pebble about the Mill-Stone.

P. This Reaſon, *Matho*, is according to the Nature of Things: Or, if I might ſo ſay, the Voice of Nature itſelf.

M. And from this View of the Syſtem, I perceive it muſt, indeed, be either Ignorance, or Obſtinacy, to contend that the Earth is in the Center, and that ſuch a Body as the Sun ſhould revolve about it. In that Caſe the Earth would ſoon be dragged from its Place, and together with the reſt of the Planets, follow him through unknown Parts, towards the fixt Stars.

P. You touch upon an univerſal and concluſive Reaſon, for placing the Sun in the Center. All the ancient Aſtronomers, (*Pythagoras* excepted) and ſome of the Moderns likewiſe, in ſettling the Order of the Planetary Syſtem, determined themſelves only by optical Appearances, (concerning which we ſpoke before) without any Regard to phyſical Conſiderations; though the centrifugal Force of Bodies is inſeparable from their moving in circular, or, indeed, any other Sort of Orbits.

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M. I thought no other Order of the Syſtem had been pretended, than the *Ptolemæan* and the *Pythagorean*.

P. Tycho Brahe, a noble *Dane*, obſerving that *Venus* and *Mercury* never appear on the Side of the Earth oppoſite to the Sun, contrived a mixt Sort of a Syſtem, where *Venus* and *Mercury* revolve, it is true, immediately about the Sun; but he, with theſe two Planets, revolves about the Earth in the Center.

M. That does not mend the Matter, with Reſpect to the centrifugal Force of ſuch a mighty Body as the Sun, revolving about ſuch a ſmall Body as our Earth: And even thus, I preſume, he could not account naturally for the retrograde Motion of the ſuperior Planets, *Mars*, *Jupiter*, and *Saturn*.

P. He could not.

M. From this I perceive more fully than before, that placing the Sun in the Center, is the only Thing that can ſatisfy both optical Appearances, and phyſical Reaſons.

P. That alone is the Order, with which a fair Enquirer can reſt ſatisfied.——

M. I now likewiſe perceive why, in giving me the Order of the Planets, you reckoned it *upwards* from the Sun to *Saturn*: For though it be *downward* to the Center of every particular Planet from the utmoſt Extent of the Sphere of its Attraction; yet ſince the Sun's attractive Power is predominant over the whole Syſtem, the *upward* and *downward*, with Reſpect to him, muſt extend to its utmoſt Limits.

P. And

P. And a great deal farther too.

M. It is somewhat unnatural to suppose it to end all at once, and at a certain Limit; it must rather grow weaker and weaker by Degrees: But pray how much higher does it reach?

P. You must be content to be ignorant of that at present.

M. Another Difficulty then occurs to me on this Subject: If the Sun's Attraction be predominant over the whole System, and at the same Time every Planet retains a Sphere of Attraction peculiar to itself, or where its Force is predominant, how is it that these contrary Actions do not disturb each other?

P. That is not a Point to be discussed easily, or in few Words.

M. I think I could manage it by myself.

P. You will certainly understand it better, if you try it beforehand.

M. In the mean Time then let us go on with the Subject we were upon before.

XLIX. *P.* You have now discovered *one* of the Forces, by which the Planets are governed in their Orbits round the Sun.

M. I have, with much Pleasure; and could almost guess at the *Cause* which impresses this Force so powerfully, so justly, and at such various Distances: Though I am not yet quite certain.

P. It is something to know the Nature of the Force itself, That it is the same which you first admired in the Fall of a Stone: For it could

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could be ſhewn by an eaſy Computation, that if a Stone were removed to the Diſtance of the Moon from the Earth, it would fall juſt as far, in a Minute, by the Force of Gravitation, as the Moon is attracted from her projectile Direction in the ſame Time. And ſince (as I mentioned juſt now) the ſame Proportion obtains in the Motion of the Satellites about their Primaries, and of the primary Planets themſelves about the Sun; we may be certain that the Attraction, which prevails through the whole Syſtem, is the ſame by which a Stone, when thrown up, falls down again to the Earth.

M. I underſtand: You argue from the Stone to the Moon; from the Moon to the reſt of the ſecondary Planets; and from the ſecondary Planets, to the *Primary*; ſhewing the Force ſtill to be of the ſame Kind. So that a Stone gravitates to the Earth, and the Earth itſelf to the Sun, by the ſame Sort of Action.

P. It is ſo: As to the Cauſe both of this and the projectile Force, it will in a little Time become plain. But that you may the better conceive the Uſe and Nature of the projectile Force, anſwer me again a few Queſtions.

M. I am ready, as far as common Senſe can ſuggeſt to me.

P. If *the attractive Force* only prevailed in the Syſtem, what Conſequence would it have?

M. The Sun, as I ſaid before, would draw down all the Planets to himſelf, where they would remain ſtrongly attracted to his Body, without any farther Motion or Order.

P. Which

P. Which Event, *Matho*, would be the final Destruction of both the animal and vegetable Nature, in the whole System; the Earth, and all the other Planets, being consumed, or quite dissipated by his raging Fire. The fourth Conference.

M. Dreadful Catastrophe! But such an Ocean of Fire was necessary, to make our Planetary World habitable.

P. How could this horrible Confusion have been prevented?

M. It could only have been prevented by a MIGHTY HAND impressing on the Planets the other Force, the Projectile, to wit, by which they tend to move on in straight Lines; that by a Composition of both Forces they might describe circular Orbits round this Ocean of Fire and Light.

P. Could this Force impressed *any how*, and *at a Venture*, have had that Effect?

M. Let me consider a little—It could not: The Quantity of this Force was to be justly attempered to the Sun's Attraction, that it might neither be too weak, nor too strong; but keep the Planets always at the same Distance. And then this just Quantity of the projectile Force was skilfully to be directed, for avoiding an equal Inconvenience. Had the Direction been oblique, either *from*, or *to* the Sun, the Planets could not have moved in circular Orbits: Some of them might have ascended without the Limits of the System, and others been carried down towards the Sun in the Center.

P. You

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P. You are satisfied then that *Art* and *Skill* were to be employed in this Matter?

M. Fully.

P. And that doing Things at a Venture might have missed of the Effect?

M. It is rather impossible that doing Things at a Venture could have reached the Effect, as there is but one Way of hitting the Mark, and ten Thousand different Ways of missing it: And that, whether we consider the adjusting the Projectile to the attractive Force in any one Body, or giving it the proper Direction when adjusted. And much greater is the Difficulty, if we take into the Consideration all the Bodies of the System.

P. What you say is very true, *Matho*; for as the Sun's attractive Force on every one of the Planets is different, so the projectile Force was to be different in each of them: And the same attempering the two different Forces, with the Propriety of Direction, was no less necessary in the Motions of the secondary Planets.——Now considering these two Forces *constantly* impressed, and also the Attraction of Cohesion if you please, you are satisfied that these are not the Actions of Matter itself?

M. I am, for Reasons which I have often repeated. A Particle of Matter cannot act ten Thousand different Ways at once, and at immense Distances. Nothing can act where it is not. This satisfies me as to the Attraction of Gravitation, that it is not the Action of Matter.

As

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As to Cohesion, if there were nothing to be overcome but the Inactivity or Inertia of Matter, that Force, which moves and overcomes the Resistance of the whole Body, must certainly overcome the Resistance of a small Particle of it, or separate that from the rest; which yet constant Experience shews to be otherwise. Though this Attraction be only between contiguous Particles, and does not reach to distant Parts; since a large Bar of Iron is not more hard and firm than a smaller Piece; yet we can by no Effort separate those least Parts, or counter-act that Force wherewith they adhere to each other. Hence it is manifest that this can less be the Effect of these little Particles, than Gravitation itself. As to the Impression of the projectile Force in the Motion of the Planets round the Sun, it was this which from the beginning I saw as much required an external Cause, as the Stone in the Sling; or rather infinitely more. It would be ridiculous to suppose that a single *Mountain*, or but a *Rock*, might of itself shoot through the Ether, at the Rate of a thousand Miles a Minute, or even of a hundred; besides giving itself a constant Change of Direction.

P. From this you must allow, that these Actions proceed from the Power of an IMMATERIAL CAUSE.

M. That was the easy Distinction I gave at first; if any Thing is not effected by Matter, it must be effected by something *not Matter*.

P. All

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P. All the Power therefore, which we ſee exerted in the material Univerſe, muſt proceed from an *immaterial Cauſe*.

M. The Connexion between this Propoſition and the laſt is ſo ſtrong, that they ſeem but one and the ſame Thing. If Matter can do nothing, all material Nature muſt conſtantly be influenced, and acted upon by *this Cauſe*.

P. This Cauſe likewiſe muſt not only be poſſeſſed of all the Power we find exerted in the material World, but alſo be *knowing* and *ſkilful*.

M. A Cauſe, which works with Intelligence and Skill, muſt be a *knowing* and *ſkilful Cauſe*.

P. Does this Cauſe only exert its Power by Starts, and in ſome Places, or always and every where?

M. The Effects we have ſeen are *inceſſantly* produced through *all* Nature;——And to ſave you the Trouble of more Queſtions, *Philon*, the Point is now become too plain, for any Perſon not to know that this Cauſe is the *All-powerful* and *infinitely perfect Being*. I had the Deity in my Thoughts ſome Time ago, but imagined you were to tell me of ſome ſecret and unknown Power in *Nature*, which performed all theſe Things; which I believe is the common Way of thinking with regard to this Subject. There is hardly any one who would allow that the Weight of a Stone, or the Hardneſs of Iron, were Effects which required the conſtant Action of the Deity.

P. It is too much the common Way of thinking, *Matho*, even among thoſe who ought

to

to think otherwise. If I might complain of the Abuse to you (whom I would wish to have quite a different Way of thinking) it is accounted the great Perfection of Philosophy, never to come to the *first Cause* (that is reckoned mean and inartificial) but to hunt after *secret* and *hidden Causes*, and so to explain the Frame of Nature, as if it were some Way or other independent and self-sufficient.

L. On the contrary, we must soon, very soon, come to the *first Cause*, if we would reason right. It is wisely and kindly so ordered that we should easily discover that *Cause*, which is the *End* and the *Reward* of all rational Enquiry. What does all my Study signify, if at summing up the Account, and after an Application of many Years, it leaves me in Doubt whether I be the Production of *Chance*, without any Design, or the Work of an *infinitely wise and good Being:* Whether I be designed for an endless Duration, or soon to drop into Non-existence? Application, without this View, ends in the most dreadful Uncertainty about ourselves. It was for this Purpose only that the rational Powers of the Soul were given us; that we might discover the *Creator* in the Works of Nature. Had we nothing more to regard than the Brutes, the *Back* and *Belly* only, and the sensitive Part of our Nature, we should have had no higher Faculties than they. ——But having once discovered the *first Cause*, which (as I have said) we may easily do; we may

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may then go on with Pleaſure and Security: We may then indulge our Reſearches into the Works of Nature to the laſt; and with greater Alacrity, as being certain that in every Step we advance, we make a new Diſcovery of the Power and Wiſdom of the Author of Nature. It is true, we muſt ſoon be loſt amidſt the Subtilty of Work, and Niceneſs of Contrivance: For a ſmall Knowledge of the Art and Power of the Creator is the Height of all human Attainments here: But even this is pleaſant and comfortable; we know by whom it is we are ſurpaſſed. Whereas, if once we paſs by the obvious Appearances of Nature, endeavouring to find the Cauſes of theſe in more hidden Operations; and the Cauſe of thoſe again, in Things ſtill more abſtruſe; and ſo at length to come to the *firſt Mover* in this Method; we are under a grievous Miſtake. It is as if we ſuppoſed our Faculties, which are over-powered with the Subtilty of Nature's Operations in the ſecond Step, were able to determine with more Clearneſs and Certainty, after they are got down among the inſcrutable *Fineſſes* of the Work. The Deity hath not left himſelf thus to be diſcovered; but hath kindly brought the ſtrongeſt Degree of Evidence, even within the Reach of the Methods of Senſe aſſiſted by Reaſon.

M. You ſeem to ſpeak with ſome Concern, *Philon:* But I perfectly conceive the Reaſonableneſs of what you ſay. Bad indeed would it be for Mankind, if Men of Leiſure and Ge-

nius only could discover from the material World, that there was a Deity; and that the heavenly Motions, and the whole Frame of Nature, are still kept in Repair by his Power. Such necessary Knowledge was intended to be easily attainable. The fourth Conference.

P. This, *Matho*, was the original Knowledge of Men in their first State. But as Disputes have been raised, and those are supposed to understand Things best, who seem to speak with Doubt and Hesitation, (this having a Shew of greater Knowledge;) I would willingly have put off the Conclusion we are now come to for some Time, till we had considered the Nature of Matter more carefully, and thereby left less Ground for doubting.

M. And for all that I think we have not been rash, nor concluded any Thing hastily, or from one Reason only: I even fancy I could, in a plain and rude Way, satisfy another Person, who was desirous to be informed about these Things; though perhaps I could not deal with an unfair and captious Adversary. However, nothing hinders us from going on with the Consideration of Matter still: This is agreeable to your own Method; we shall go forward with the greater Alacrity, as being certain that in every Step we advance, we shall make a nearer Discovery of the Power and Wisdom of the *Author of Nature*.——I began to think, that the Reason why you kept me so long on the Examination of Things, before we came to this Conclusion, was, That I might

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have some previous Conception of the Power and Wisdom of the Deity, from the Greatness of the Effects he constantly produces: For I find I could not have had so full a Notion of these, by being simply told, *his Perfections were infinite.*

P. That had been a very justifiable Reason, *Matho*, if I had had it in my View. It is easy to pronounce these Words, *A Being of infinite Perfections*, and other Expressions of this Kind; but we frequently use them rather as Words of course, mere technical Terms, when we speak of the Deity, than as having any tolerable Notion of what they import. Nor is it easy for such Creatures as we are, whose first Information of Things is from Sense, to have so strong and lively a Conception of infinite Power and Knowledge any other Way, as by contemplating the Effects of these Perfections in the visible Creation.

M. I am convinced that the Method we have taken was the best we could have taken. —— But what Ground for doubting have we left?

P. None, I think, to a fair Enquirer: But you must not expect always to meet with such. For some have denied that the Fabrick of the Universe owes it's Origin to Wisdom and Design, or is governed by Power and Knowledge.

M. Must not such an artful Contrivance of this Frame, and nice Adjustment of one Thing to another, have proceeded from Reason and Design?

P. They deny it did.

M. What Sort of Effects are those then, which Reason and Design produce, according to these Men?

P. No Sort of Effects at all.

M. How can they who deny this, shew that they themselves are reasonable Beings?

P. By endeavouring to overturn your Reasons.

M. Can they shew such strong Marks of Reason in this Attempt, as those are which they deny to be Marks of Reason in the Works of Nature?

P. They themselves must look to that.

M. Do they know all the Instances of Art in the Works of Nature?

P. No Man on Earth can pretend to know them, in respect of any one Particular: All is Art till our Faculties fail in the Investigation.

M. They cannot therefore be Judges of what they do not understand. I remember what you said, when we were speaking of the Usefulness and Necessity of Mountains on our Globe. Ignorance only can make a Man find Fault with the Contrivance and Beauty of the Universe.

P. There is a pretty famous Story told to this Purpose, *Matho*, of a certain King, who, not understanding the Order of the Planetary System, said, Had God consulted him about the Contrivance, he could have shewn how it might have been mended *.

* ——*Il osa dire* [*Alfonse dixiéme Roy de Leon*] *que si Dieu Lui eût fait l'honneur de l'y appeller, Il Lui auroit donné de bons conseils.* Moreri in Alfonse.

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M. Poor Mortal!—As to the Power diſcovered in the Motions of the heavenly Bodies, do *theſe Men* contend that the conſtant Retraction of the Planets towards the Sun, contrary to the Tendency of Bodies revolving about a Center, proceeds from nothing? Do they ſay that the firſt Impreſſion of the projectile Force on ſo many prodigious Globes of ſluggiſh Matter, and the exact Adjuſtment of that Force to balance the conſtant centripetal Tendency, required neither Power nor Art in the *Cauſe?*

P. They aſcribe all thoſe Things to Matter itſelf.

M. Do they aſcribe to Matter thoſe Things, the performing of which it ſtruggles againſt? Matter at Reſt, ſtruggles againſt being put in Motion; when in Motion, it ſtruggles that it may not be turned out of its Direction ſtraight forward: And therefore it cannot perform that, the Performance of which it reſiſts. What do they ſay to this?

P. I do not really know.

M. Could you anſwer any Thing for them?

P. Nothing, indeed, if I ſpeak Senſe: Perhaps they may ſay, that Matter does not reſiſt neceſſarily, and of itſelf, to be put in Motion, or turned out of a ſtraight Direction, when moving.

M. Another Cauſe then, different from Matter, muſt be neceſſary, by whoſe Aſſiſtance Matter might reſiſt; and it would be extremely fooliſh in them, to deny a Cauſe different from

from Matter, and yet have Recourse by *a Cause different from Matter.*

LI. *P.* Now stop a little, *Matho*, and consider what you have done. You will find that you have concluded more in few Words, than I could have shewn you by many Arguments.

M. You'll make me vain.

P. Nothing like it: For from the Resistance of Matter, you have shewn the *absolute Necessity* of an immaterial Cause, let an Adversary say what he will, or be ever so unfair and captious. If Matter necessarily resists a Change of State, whether of rest, or moving uniformly forward, an *immaterial Cause* must be necessary to overcome its Resistance: If it doth not of itself, and necessarily resist, an *Immaterial Cause* must still be necessary, by whose Assistance it may resist.

M. I see in either Case, the Sluggishness or *Inertia* of Matter appears undeniable: For if Matter necessarily resist a Change of Motion, or of Rest, it cannot effect that which it resists: And if it resists only by the Help of another Cause, it can as little produce the Effect as before, nor even resist producing it, without Assistance from something else. This is making it the most impotent Thing we can have any Notion of.

P. We could not form a Notion of any Thing so sluggish and impotent, and that on every Supposition, unless from this very Substance. So sluggish, that you may defy the

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fierceſt *Sceptick* to doubt of its Inactivity. The Inertia of Matter is one of thoſe Things, which, by being doubted of, forces the Mind to aſſent the contrary Way.

M. Yet from this two-fold Notion of the Inertia of Matter, I perceive that it muſt be good for ſomething, on the firſt Suppoſition; namely, that it neceſſarily reſiſted all Change of its State of Reſt or Motion: But on the laſt Suppoſition, *viz.* that it made no Reſiſtance to a Change of its preſent State, it would be utterly unfit for any Purpoſe in Nature.

P. Pray ſhew me by ſome Example, on what Ground you make this Obſervation.

M. If a Body did not reſiſt to be brought to Reſt, when it is in Motion, it could have no Force, nor produce any Effect. When a Cannon Ball is diſcharged againſt the Wall of a Town, if it made no Reſiſtance to a Change of its State of Motion, it might be ſtopt by the leaſt Force, and would not ſignify ſo much as a Puff of Air.

P. Be a little more particular; would it require any Force at all, leſs or more, to ſtop it?

M. I mean, it would require no Force; otherwiſe it muſt make ſome Reſiſtance, contrary to the Suppoſition.

P. Then all the Force, or Effect, which a Body in Motion has on any other Body, proceeds from its Reſiſtance to change its preſent State?

M. That is, indeed, my Meaning.——And again, if a Body made no Reſiſtance to be put

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in Motion, the greatest Body, a *House*, a *Rock*, a *Mountain*, or the *whole Earth*, might be moved with the least Force, or rather with no Force, since it could make no Resistance to be moved with any possible Celerity.

P. Might not the mutual Cohesion of Parts in a *Rock*, keep it fixt, and immoveable?

M. If they kept the Rock firm in itself, the Earth and all must be carried along, since nothing could make Resistance. But why should the Parts cohere at all? This would be only Resistance to change their State of Rest among themselves.

P. That is very true: Go on.——

M. Where would this end then; or what consistent Consequence could it have? If a Body in Motion came up upon another Body at Rest, the first might be stopt by no Force, the second might be moved by no Force, since neither could make any Resistance to a Change of its present State. Whereupon I ask you this Question, *Whether would they both move on, or both rest?*

P. I cannot answer it.

M. If the first Body were stopt, Motion is taken off by nothing; if the second moved along, Motion is excited by nothing. This makes Motion to be *nothing*. A Thing produced by no Cause, and put an End to by no Cause, must be *nothing*, if Language could express such contradictory Notions.

P. I agree with you, *Matho*; the Motion of such unresisting Matter (if such Motion be

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not contradictory,) must be as ineffectual in Nature, and therefore as useless, as Rest. Whatever Effect is produced by Matter, is produced by *resisting Matter*. The Particles of Light, which are reckoned the most subtile and active, are yet *resisting Matter*; as we may experience by the Heat and Motion they produce in Bodies. The Atheist, therefore, by taking away the Resistance of Matter, must take away the Use both of Matter and Motion in the World; by which notwithstanding he would have all Things to be performed, and produced, without the Help of a Deity.

M. This Supposition also takes away, I think, the Nature of Matter itself: Otherwise, I would ask this Question; If two equal Bodies, moving with equal Celerity, should meet one another, what must the Consequence of their Meeting be? Could there be any *Shock* between them? Would they stop on coming to Contact; or could they bear a Touch?

P. There could be no Shock between them; nor do I see that they could bear a Touch, since that would shew Resistance to a Change of their State of Motion.

M. This makes Body then a mere Shadow, and nothing substantial.

P. You are certainly in the Right, *Matho:* Matter that could *communicate* no Force, could *bear* no Force; and Matter that could *bear* no Force, would not be solid Substance, but only the Phantom or Shadow of Matter: Which Conclusion of yours will also appear thus. Unresisting

resisting Matter could not *communicate* Force, nor *bear* Force; nor therefore *withstand* that constant Impression which it receives in Cohesion.

M. I have some Notion of this; but pray shew me how it is, for I am too impatient to think about it?

P. Suppose a Weight suspended by a Wire of Metal, so great, that the Wire could support no more without breaking. The Parts in the Thickness of this Thread of Metal, through it's whole Length, by their firm Cohesion, resist the whole Force of thirty, or forty, or fifty Pound Weight perhaps, according to the Thickness of the Wire: For if in any Part the Resistance were less, or the Cohesion less strong, the Wire must break there, and the Weight fall down.

M. I take it.

P. But the Cohesion of its Parts is not stronger now, than when the Wire supports no Weight.

M. Certainly it is not; for the Weight doth not increase the Strength of the Wire, but only tries it.

P. Every Part then in the Thickness of this Wire adheres to the contiguous Part, by a constant Impression, equal in Force to the greatest Weight it could suspend without breaking.

M. I see it plainly. Hence it is equally pleasing and wonderful, to consider the strong Impression which firm Bodies constantly sustain in all their Parts: And surely if Matter could

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could bear no Force, it could not ſuſtain this conſtant Impreſſion, nor be ſolid Subſtance; but yielding to the Force, or rather before the Force (for it is difficult to expreſs the Caſe conſiſtently,) be at laſt reduced to nothing. I perceive the Anſwer I gave you, with Reſpect to the Coheſion of the Parts of the Rock, was right: If it were unreſiſting Matter (I mean, if that did not imply a Contradiction) its Parts could not bear the Force of the Impreſſion in Coheſion, nor the Force of its own Gravity to the Earth; that is, it could have no Gravity; nor therefore could they make any Reſiſtance to be moved. And the Argument is the ſame in every Part of Matter, between whoſe Particles there is any Degree of Coheſion: And that is, I think, in all Matter.

P. You touch upon another Particular, *Matho*, concerning the Gravity of the Rock, which ſhews us the ſame Truth univerſally. If Matter could bear no Force, it could not gravitate to a Center, nor be weighty; ſince Weight, or Tendency to a Center, you know, ſuppoſes Force impreſſed.

M. I remember it. A Body gravitates no leſs, when ſuſpended in a Balance, or while it is in the Air, than when it lyes on the Ground. And Matter bears this Impreſſion, though it is not in Contact with the Body to which it tends; otherwiſe it would tend to that Body with no Force, or, not tend to it. This, I perceive, would diſſolve the Cement that keeps together the material Univerſe? for *attractive* Force,

Force, *centrifugal* Force, *projectile* Force, would be then impossible. The fourth Conference.

P. This also is no less true in the *Repulse*, than in the *Attraction* of Matter. When we endeavour to compress the Particles of Air, they bear a prodigious Force, without coming into Contact: And the Under-parts of the Atmosphere still support, after this Manner, the incumbent Weight of the Upper-parts. In short, as it is by Resistance that the Parts of all Bodies, whether *animal*, *vegetable*, or *unvegetating*, act upon one another in all natural Operations; and as it is by Resistance that they could either communicate Force, or bear Force; unresisting Matter would not only be of no Use in the World, but is a contradictory Notion; since the least Force, or rather, indeed, no Force at all, might then consume, and quite annihilate all the Matter in the Universe.

M. I understand it fully: This Notion of unresisting Matter destroys the Substance in all Senses.

LII. And now, *Philon*, from this nearer View of Matter, I see, with Pleasure, that it must necessarily resist all Change of State, as it is a solid and impenetrable Substance: And if we do not conceive it as resisting a Change of State, we cannot conceive it as solid and impenetrable; nor in Truth have any Conception of it at all.

P. Since this is so, I hope you are now satisfied of a Point, which from the Beginning

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ning you allowed to be extremely probable.

M. What was it?

P. That *Change of Place*, *Tendency* to any Side, *Motion* of any Sort, or *Change of Direction* when in Motion, does not belong to Matter, or Body.

M. I am so much the more satisfied, that Matter can effect none of these Changes in itself, as it requires a positive Force to be impressed upon it, in order to overcome the Resistance it makes to the Change.

P. And if it required no Force to be impressed upon it, or had not this stubborn Inactivity?

M. Then it could be of no Use; or it would only be the Phantom of Solidity, and not real Body; more than the Shadow of a House is a House, or the Picture of a Tree is a real Plant. ——And this is what I most admire, *Philon*, that the very *Deadness* of Matter, or its Resistance to the Performance of any Effect, should be made the Means of its doing all that it performs. This seems to me the strongest Proof of a *living* and *immaterial Power*, constantly working in all Nature, and actuating this Substance, that the Heart of Man can conceive or desire.

P. We shall therefore reason for the future concerning this Substance, with more Security, and less Fear of making false Conclusions.—— But have you a Notion of any Power besides a *living* and *immaterial Power?*

M. Since

M. Since what Matter *does*, is only by *resisting to do*, there is no Power besides *immaterial Power:* And no Man can have a Notion of what is not. As to *dead Power*, it is a direct Repugnancy. The fourth Conference.

P. Can there be Power in Nature, without a *powerful Being* to whom it may belong?

M. Every Perfection, as I apprehend, must be the Perfection of *some Being:* A Perfection that belonged to *nothing* is again a Repugnancy; no Perfection.

P. Could there be Knowledge in Nature, without an *intelligent Being?*

M. I have told you my Thoughts with respect to every Perfection. Knowledge must be the Knowledge of some Being. There can be no Knowledge in *inert Matter*, or *empty Space:* An intelligent Being therefore must be different from these.

P. If you add all possible Perfections together, could they exist without a Being to whom they belonged?

M. If they could not when supposed separate, they could not when taken all together. They must rather belong to a Being as perfect as possible.

P. But how do you know that they are consistent, so as to belong to the *same Being?*

M. I have a Notion that they cannot be inconsistent; and yet I cannot give a Reason why.

P. Reflect a little, and consider them as really inconsistent.——

M. You

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M. You have set me right. If Power were inconsistent with Knowledge, it would be only *blind Force*, *pure Chance*, or *Temerity*. If Intelligence or Knowledge were inconsistent with Power, it would be as useless in the Universe of Things, as a *Surdity of Nature*; since however well it might contrive, it could perform nothing. *Power* without Knowledge would be hurtful; and *Knowledge* without Power as unavailing to any Thing else, as a *blind* and *unintelligent Nature*; and to the Being itself it would even be a Misery, as subjecting it to the cruel Reflections of its own Impotence to act what it saw was right.

P. Thus you see, if any Perfection were inconsistent with another Perfection, it would become an Imperfection on Account of that very Inconsistency.

M. So I perceive: An Inconsistency with a Thing that is good, must be *bad*; and to be inconsistent with what is right, must be *wrong*.

P. What think you of *Goodness*, or *Justice* then?

M. Let me consider; these Things are new to me.——Goodness, I apprehend, supposes a *kind Intention*, with Power to make it effectual; that is, it includes the Notion both of Knowledge and Power. Without Power the Intention would be unprofitable; and without Knowledge impossible. And if Goodness were inconsistent with Justice, it would only be an Encouragement to Disorder and Licentiousness. As to Justice,——the very Conception of it seems

seems to include Knowledge, Power and a right Intention. And it is as much Goodness or Kindness as the Encouragement to Virtue, and Discouragement from Vice can be. The fourth Conference.

P. You are of Opinion then, that each of these Perfections includes the rest, or that any one of them consists of all?

M. You have brought me, by this Sort of reasoning, to see that it must be so; or that so far as it is otherwise, they are imperfect, or Perfections in an inferior Degree: For in a supreme Degree *any one* naturally supposes *all the rest* without Limitation. Only I think Goodness and Justice respect intelligent Beings; whereas Power and Knowledge may regard the material World.

P. Could Power and Wisdom be manifested, think you, to the material Frame of Things, if there were no intelligent Beings in it?

M. It must have been inconsistent to have designed to manifest these Perfections to mere Matter; since Matter is not capable of perceiving the Art and Power manifested in itself.

P. If Power and Knowledge then were manifested in dead Matter, for the sake of intelligent Beings; they come under the Denomination of *Goodness*.

M. This shews me indeed the nearer Alliance of these Perfections.—But these Things, though I begin to find Pleasure in them, will carry us from our Subject.

P. Let us diversify the Subject a little; there is Pleasure in Variety: And we will return

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turn to the Consideration of Matter instantly.——Tell me therefore, since each of these Perfections naturally include the rest, can any Thing in Nature disjoin *such Perfections*, whose Nature it is to be joined together?

M. I am really at a Loss what to answer here.

P. Consider well what is in Nature; and what is the Nature of these Perfections.

M. You have taught me now to consider Nature, as only consisting of *dead Matter* on the one Side, and *Power* and *Knowledge* on the other.——Yes, this shews it me indeed. Since it is the Nature of these Perfections to be joined together, nothing in Nature can disjoin them. For that Thing, which could disjoin them, must be contrary to their Nature. But the Things of a contrary Nature to *Power* and *Knowledge* are only *Impotence* and *Ignorance*, which are mere Negations, or *Nothing*, and can do nothing. Power and Knowledge therefore are necessarily united in Nature.

P. And the Things contrary to *Goodness* and Justice?

M. Are *Malice* and *Tyranny*. But Malice supposes *Envy* for the Want of Power and Knowledge, to procure some Advantage, which the malicious Being is conscious it has not. And Tyranny supposes *Fear*, for the same Want of Power and Knowledge to secure Advantages, which the Being is, or supposes itself to be possessed of. And Power and Knowledge (the Defect of which gives Rise to Malice and Tyranny)

ranny) are necessarily united to Goodness and Justice.—

P. You seem to be thinking on something farther.

M. By this I see, that it is the Sovereign Degree of Power and Knowledge, that is necessarily and naturally united to Goodness and Justice. It is impossible that a Being of infinite Power and infinite Knowledge, can ever be malicious or envious, or (therefore) tyrannical; since he can see nothing but what is below himself. But from the Instances of Malice and Tyranny I perceive, that a finite Degree of Power and Knowledge may be disjoined from Goodness and Justice; or it is their being limited, that can only disjoin them from the other two.

P. From what you have said then, it follows, that Malice and Tyranny, (or, in other Words, *Envy* and *Fear*,) have no Foundation in Nature, except a Defect of Power and Knowledge; that is, except the two first Negatives, *Ignorance* and *Impotence?*

M. So it seems to me.

P. And that the four Perfections we first named, viz. *Power*, *Knowledge*, *Justice*, and *Goodness*, are united by their Nature, provided they be in a sovereign, or infinite Degree?

M. It is so. And since nothing can oppose their Nature, they are united by the strongest Necessity I can have any Notion of.

P. But could these Perfections have been produced, or have been the Effect of any Cause?

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M. That ſeems, to me, wildly contradictory.

P. Why ſo?

M. The ſuppoſing them to have been produced, is the ſame Thing as ſuppoſing them once not to have been; and then there could have been nothing to have produced them, except their *Contraries*, which are mere Negations. But it is the greateſt of Contradictions to ſuppoſe, that *Impotence* and *Ignorance* ſhould produce infinite Power and Knowledge. So that they are abſolutely neceſſary in themſelves.——

P. So neceſſary are *Power* and *Knowledge* in Nature, *Matho*, that if we deny their abſolute and inconditionate Neceſſity, we affirm their abſolute impoſſibility; ſince there was nothing in Nature to produce them. This again is another of thoſe Inſtances, where it is impoſſible for the moſt diſingenuous *Sceptick* to doubt, with his utmoſt Effort. They muſt likewiſe be *infinite*, or *unlimited:* For they could not have limited themſelves, or made themſelves leſs Perfections than they *neceſſarily* were. That neceſſary Power and Knowledge ſhould leſſen, or limit themſelves, is both morally and phyſically impoſſible. And there was nothing elſe in Nature to limit or leſſen them: Nature conſiſted of nothing elſe. *Ignorance* and *Impotence* are ſtill *nothing*. Add to this, that it is *ſomething poſitive* that muſt be infinite: And nothing is of ſuch a poſitive Nature as ſuch Perfections, and thoſe *neceſſary*. You ſaw before, that Infinite joined to a Negation

tion (that is, *infinite Nothing*) is absurd. Infinite Deadness, infinite Weakness, infinite Ignorance, makes the Perfections, which are thus infinitely denied, again impossible.—— Lastly, they must be undivided as well as unlimited, for the same Reasons, which it is almost needless to repeat. Division is Limitation. It is their Nature to be united. They could not have divided themselves. Infinite Power, or infinite Knowledge, could not have divided, and thereby lessened itself: This is again both morally and physically impossible. And as there was nothing else in Nature, (for they make all Nature, if I may so express it;) they could not have been divided: We must still remember, that their Contraries are nothing, and could not make a Part of Nature. ——Thus we have helped each other, *Matho*, to such a View of the *Unity* and *absolute Perfections* of the SUPREME BEING, as your mentioning *living* and *immaterial Power*, in opposition to the Deadness of Matter, laid in our Way. The fourth Conference.

M. When one considers the necessary Nature of these Perfections, all Things in Nature else seem little and transitory, and almost to disappear. It is really a noble Speculation! and no less comfortable than pleasant, to find an *Infinity* of Power, and Knowledge, and Goodness, and Justice, absolutely necessary.

P. Virtue must triumph at last. The good Man has so little Reason to doubt, that he is not surer of what he is possessed of, than he is

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of immortal Happineſs: But I mention theſe Things a little prepoſterouſly to you now.

M. No; I underſtand them well, and ſhall often think on what you ſay.

P. Try the Reaſons when you are merry or ſad, in Health or Sickneſs, at Death itſelf; you will ſtill find them hold.

M. Though this has been a ſevere Bout to me, I am extremely glad we entered on the Subject.

LIII. And here, I obſerve, that this Sort of Proof for the Being of a Deity, though abſtracted, as indeed it ought to be, ſeems very natural. For as his Exiſtence is abſolutely neceſſary, and independent of any Thing elſe, ſo there muſt be a Reaſon for it, (or rather, the Reaſon of it muſt be) independent from any Conſideration of the material World.

P. The Obſervation is juſt; and ſuch a Proof muſt of Conſequence be abſtracted, as having nothing to do with the material Nature. It is ſuch a Proof as would conclude, before Matter exiſted, or after it ceaſed to be: And it would be hard to affirm, that the Reaſon for the Being of a God ſhould diſappear with the material Univerſe. However, it is wiſely ordered, (as we obſerved before) that the ſtrongeſt Degree of Certainty is brought down even to the Methods of Senſe: And it muſt be owned, though we may infer in an abſtracted Manner, that the Power and Wiſdom of the Deity are neceſſary and infinite; yet without

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the Wonders manifested in the Creation, we could not have such strong and lively Conceptions of these Perfections: Besides, the pleasing Circumstance of considering the Deity in the Relation of our Creator; and beholding constantly the Operations of his Power and Goodness.—— The fourth Conference.

M. To return then, since the Existence of a Deity is so many Ways undeniable, and his Power so visible, what Reasons do the Atheists give for saying, that Matter and Motion may do all that is done in Nature?

P. I put the Question to you again, *Matho:* Do you think there could be any Reasons for such an absurd Opinion?

M. I am satisfied there could be none solid.

P. Do you think they could even appear probable to an impartial Enquirer?

M. That I cannot tell, unless I knew them. It is hard to conceive what Men could mean, unless they had some Shadow of Reason, whereby they deceived themselves at least.

P. And notwithstanding, you brought the Point between you and them soon to a Decision.

M. Yes, with Respect to the Motion of the heavenly Bodies.

P. You have seen that Matter resists all Change of State, and therefore it resists to be put in Motion.

M. How then do they account for its being put in Motion?

P. In truth, *Matho,* what they say is so silly, that, if I should take their Side of the

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Queſtion, you would ſuſpect I wronged their Arguments. They ſay, *Matter was eternally falling downward, through the infinite Abyſs of Space; but that having ſome how or other a Side-Motion, its Parts came to touch, and ſo formed a World.* How does this pleaſe you?

M. It is quite below Contempt. I am a thouſand times more ſurprized than I was, that ever there ſhould be an Atheiſt in the World.

P. Let them ſay then what they will, as long as they deny an intelligent and powerful Government in Nature; I ſhould expect now, that you could ſhew the Abſurdity of what they advance. And pray, though we ſhould allow that Motion were thus natural to Matter, would it not be as much a dead Subſtance, as if it had been without Motion from Eternity?

M. It certainly would; for Matter at preſent is as much a dead unactive Subſtance in all the Changes it undergoes, as if it remained ſtill in the ſame State: And this proves to me that though ſuch Motion were natural to it, nothing could be effected, unleſs this Motion were over-ruled by *Intelligence* and a *governing Mind.*

P. Your Reaſons for ſaying ſo?

M. It is almoſt a Shame to argue againſt the Atheiſt's Suppoſition. If Matter had naturally ſuch a Tendency, it muſt ſtill fall down through the Immenſity of Space, as well when in Contact, as in ſeparate Particles, without ever producing any Thing. And this ſhews

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us again, in a very particular Manner, the Absurdity of an *universal downward*, or that Gravity was a connate and inherent Property of Matter. But let us even suppose that a mutual Attraction between all its Parts, such as we took Notice of before, were essential to Matter; or that its Particles could act where they are not, and that to all Distances: This could only bring the whole Substance into one prodigious Heap, which must afterwards remain without Change or Motion of its Parts. And we see before too that to prevent the great Bodies of Nature from coming thus together, they are made to move in circular Orbits, whereby a centrifugal Force is excited in them.

P. Suppose once for all, that every Sort of Motion, backward and forward, circular and rectilinear, were natural to the Particles of Matter; and then consider whether they could produce a World.

M. Are you able to make such a Supposition as this, *Philon?* I thought I had gone Lengths enough. It is absurd to suppose so many Contradictions, in order to try the Truth of any Thing, since one Contradiction must shew it false. It is to bid me consider whether the Atheist's Scheme would be possible, if it were three or four Times impossible. It was probably by considering Things in this confused Way, that the Atheist at first bewildered himself; and that other Mens Eyes have been dazzled. Matter resists to be put in Mo-

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tion, and when put in Motion, it reſiſts a Change of Direction. Thus if the Particles moved all one Way in this ſtraight-lined Motion, we have ſeen that nothing could be effected. If they all moved contrary Ways when they encountered, the ſtronger muſt carry the weaker along with them; or if the contrary Forces were equal, both muſt reſt. And what agrees to two Particles agrees to the whole Maſs. Some Parts of Matter might ſtill move farther aſunder through the infinite Space; and the Motion in others being deſtroyed, they muſt remain eternally at Reſt.

P. You reaſon perfectly well, *Matho*; the Quantity of Motion once loſt, could never after be recovered on this Hypotheſis; nor indeed on any Hypotheſis, except by *immaterial Power*. It is thus the Quantity of it, which is ſtill decreaſing by the Action of Matter upon Matter, is conſtantly renewed by the firſt Cauſe. Let the Motions of the Particles therefore be ever ſo various and irregular, when contrary they muſt deſtroy one another, and the Particles after that reſt; otherwiſe the Atheiſt might ſuppoſe his Matter in a State of Reſt at firſt, and then to impreſs Motion on itſelf. And after all, nothing could be produced on theſe Suppoſitions, but Motion by ſtraight Lines or endleſs Reſt. Much more might be added if it were neceſſary. Though he ſhould imagine the Particles to ramble backward and forward, like *Gnats* flying in the Air in a Summer-Evening, this could never

ver produce *Cohesion of Parts*, *Order* or *Arrangement*: Matter agitated by so many wild and tumultuous Motions, would only so much the more stand in need of *a powerful* and *intelligent Cause*, to restrain *these*, and impress other Motions consistent with some regular Design. The fourth Conference.

M. I understand the Case as you expressed it in all its Perplexity. The more they multiply these blind and unguided Motions, the more they make an *intelligent Principle* necessary, to over-rule and direct them: Since Matter, tossed in such a wild Manner, must be more unmanageable, than when at perfect Rest.——But as there is no Pleasure in pursuing these Absurdities any farther, and as we have not yet spoke of the *Cohesion of Parts* in Matter, otherwise than as it came in our Way accidentally; pray resume that Subject a little.

LIV. *P.* Tell me then; Must not any Particle of Matter, the less it is, yield to the less Force impelling it?

M. Without all Doubt; and the greater it is it must require the more Force to be moved with the same Celerity.

P. Could a Particle resist a hundred or a thousand Times a greater Force than that is to which it yields?

M. That is plainly repugnant; or it is saying, *the Particle can do more than it can do.*

P. And is not the same Thing true of any other equal Particle?

M. It

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M. It is as true of the ſecond as of the firſt, and of the third as of the ſecond, and ſo on, for any Number of equal Particles

P. Let us ſuppoſe then that a Bit of Iron conſiſted of three or four ſuch Particles; and do you think that theſe Particles could be ſeparated from each other, by the ſame Force by which they could be moved if they were ſeparated?

M. No; not by a thouſand Times a greater.

P. Is this thouſand fold Reſiſtance made by the Particle itſelf?

M. Certainly it is not; for that would be to affirm that it made a thouſand Times a greater Reſiſtance than it can make; a ridiculous Contradiction.

P. Whence does this Exceſs of nine hundred and ninety nine Times a greater Reſiſtance than the Particles can make, proceed then?

M. This diſtinct Manner of arguing, *Philon*, ſhews me undeniably, that ſuch a prodigious Exceſs of Reſiſtance is the immediate Effect of immaterial Power. But is any Thing offered here with a View to account for this wonderful Effect otherwiſe? I ſhould think that Men muſt have inſtantly owned the Hand of the Deity in ſuch a plain Caſe.

P. It hath been ſuppoſed that ſuch little Particles are joined together by certain other leſs Particles, in the Form of *Hooks* or *Claſps*, which keep them fixt together.

M. They

M. They should have supposed then, that the whole Substance of Iron, or other such hard Bodies, consisted only of these *Clasps* or *Hooks:* For such Bodies make equal Resistance every Way, to be divided, or have their Parts separated. Besides, must not such *Clasps* be less than the Parts they clapsed together? The fourth Conference.

P. We can hardly conceive it otherwise.

M. And must not the *Parts* of these Clasps be less than the Clasps themselves?

P. Without Doubt.

M. What then clasps together the Parts of these little Machines?

P. That I cannot tell.

M. This leaves the Point unsolved, or rather makes the Difficulty greater: Since (as we observ'd just now) any Particle, the less it is, must yield to the less Force impelling it. And here the direct contrary is supposed.

P. Such Suppositions, *Matho*, (that I may acquaint you with this by the Way) are frequent in the mechanical Explications of the Appearances in Nature.

M. What do you call *mechanical Explications*?

P. That is called a mechanical Explication when the Effects, which appear in Matter, are said to be produced by other Matter, of which the present Case is an Instance.

M. I understand; when the Matter of the Body is allowed unable to produce the Effect, other Matter is supposed sufficient.

P. That

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P. That is it.

M. I ſhould make no ſcruple to reject ſuch Explications, eſpecially where the greateſt Efficacy is aſcribed to the leaſt Particles, which certainly have the leaſt *Reſiſtance*, by which only they can effect any Thing. And the preſent Explication of the ſtrong Coheſion between the Parts of Bodies only ſuppoſes that it is the Effect of the ſtronger Coheſion of leſſer Parts!

P. Some have endeavoured to explain the Coheſion of the Parts of Bodies, by the Preſſure of ſuperincumbent ſubtile Matter; for which ſome Experiments are alledged.

M. Does not this Matter preſs upon all Bodies equally?

P. Without Doubt.

M. Then the Parts of all Bodies ſhould adhere to each other with equal Force; and it would be as difficult to break a Piece of Glaſs, as a Plate of Iron. Beſides, how could this Matter get in, to cauſe Coheſion between every Part of the hardeſt Bodies? By pervading them all poſſible Ways, it ſhould rather looſe the Coheſion, and diſſolve the Body.

P. A great Philoſopher was of Opinion, that *Reſt* only cauſed Coheſion between the Parts of Bodies.

M. How many Degrees of Reſt are here? The Degrees of Coheſion ſeem innumerable. Reſt between the Parts ſeems rather the Conſequence than the Cauſe of Coheſion. And if I can

I can overcome the Resistance of the whole Body, by putting it in Motion; why should I not be able to overcome the Resistance of a Part of it separately? The fourth Conference.

P. There are other Explications of this Appearance, but not worth mentioning.

M. And from those you have mentioned, I am still more satisfied, that the strong Impression constantly made on the Parts of firm Bodies, which you shewed me from the Instance of the Wire suspending a Weight, cannot be the Effect of a material Cause. A small Bit of Iron could bear an inconceivable Pressure, before it could be flatted, or the Parts of it separated from that Contact they are in with others; and yet the natural Resistance of the whole Piece, proceeding from its Inertia or Deadness, might be overcome by the Strength of an Hair.

P. You are likewise satisfied that this Impression must be constant.

M. As much as I am, that the Strength and Firmness of these Bodies, which support the largest Edifices, and bear the greatest Weights, must be constant. *The Weight does not increase but try the Strength of such Bodies.* If it were otherwise, the stateliest Piles of Building must instantly tumble; and the Bodies of Animals be loosened into Atoms. Nothing in Nature could remain the same; nothing could bear to *touch* or to be *touched.* I need not mention what occurs to me every Time I think on this Subject; That if this Impression

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were not *various* to constitute the different Species of Bodies, if all were as hard as Iron, or as soft as Wax; if all were equally brittle, or equally tough and supple; the Fitness of one Thing to another, and the Use of all, would be lost in Nature. These Things fill the Mind with Amazement, which is ever new.

P. You said, without this constant Impression, the Bodies of Animals must instantly be loosened into Atoms.

M. Certainly. Every Bone in our Body bears a constant Impression of Force, equal to the greatest Resistance it could make, before it were broken. And this, indeed, is astonishing, (for you make me attend to it,) that our Bodies constantly bear an Impression, which, one Way applied, would crush and dissolve them; and another Way applied, is not only not felt, but preserves us! Besides, there is almost all the Difference of Impressions in the animal Body alone: The Bones are hard, the Flesh soft, the Sinews tough, the Blood loose and fluid.

P. The more we think on these Things, *Matho*, the more various we must see our immediate Dependence on the Power of the Deity to be.

LV. *M.* There is still another Particular in the Cohesion of the Parts of Bodies, which seems to me exceeding wonderful.

P. What is it?

M. Though the Variety of this Action, and the

the different Force of the Impression in different Sorts of Bodies, is beyond our Conception; yet if we might compare Things which we do not comprehend, one with another, the Subtilty of the Action appears still more astonishing.

P. I should be glad to hear your Thoughts on this Head.

M. We observed from the Beginning, that Cohesion is only between the contiguous Parts; the whole Force of the Action, therefore, is only between these: But they are the least Parts of Matter which can be contiguous to each other, since Matter can only come to Contact by its Surface, and not by its Depth or Solidity. So that, I think, they are only the Surfaces of the least Parts, that make all the Resistance, even in the very hardest Bodies, as *Steel* or *Adamant*. So far I should have a clear Conception: But if I consider these Surfaces, as not the Solidity of the Parts, but that these Parts must have other Parts; the Subtilty of this strong Action, which effects Cohesion among the Parts, exceeds my Imagination. For I can conceive no Part of Matter so little, but what might afford Room for a Separation, or for two new Surfaces to be made out of it. This multiplies the Action to a Minuteness that surpasses my Faculties, (as I said,) and yet without diminishing the Strength of it.

P. Here, I believe, every Body's Faculties must fail them, *Matho*, as well as yours. What you have said, seems very just; and, besides

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what you intended, it shews us a new Reason, why this strong and subtile Action could neither be the Effect of other Matter, nor of these little Particles themselves.

M. That I had in View, when you told me of the *Pressure of a superincumbent subtile Matter*. It is strangely contrary to Reason, to suppose, that such minute Particles should be so impelled by other Matter, as to exert such an Effort. Those small Atoms could not afford *Room*, *Scope*, or *Surface* enough, for other Particles to act upon them: And then the Impulse of other Matter could never explain, but must perplex this Affair beyond Conception. If other Matter impelled a Particle on all Sides equally, the contrary Actions suspending each other, that would dissolve its Cohesion with any other Particle. If the Particle were impelled more strongly on one Side, that must loose it on the other. Lastly, there should be more of this *other Matter*, I think, in the very hardest Bodies, than of their own proper Matter; since every Atom of them would want to be impelled on all Sides. This would be a strange round about Supposition, made to shew the Cohesion of the Parts in Bodies impossible: And the Cohesion of these other Particles is still left unaccounted for; as also how they come to have this Motion and Direction, so as to impel constantly all the Parts of all Bodies.

P. Besides, *Matho*, since the Force, wherewith every little Particle attracts the contiguous Particles,

Particles, acts on all Sides, and every where round; and since no Particle can have opposite Tendencies, or a Tendency, to all contrary Sides at once; it is plain that Cohesion can neither be the Effect of any other Matter from without, nor of these Particles themselves from within; but *the constant Impression of a superior and Divine Power*, exerted in a Manner by us altogether inconceivable. The fourth Conference.

M. I understand what you say: A Particle could no more have a Tendency to all Sides at once, than it could move to all Sides at once: And a Tendency to one Side could never cause Cohesion, even on that Side. It is delightful to see a Point, which carries such important Consequences along with it, admit of so clear a Decision.

P. Finally, *Matho*, if we consider what you expressed so well in the Beginning, when you said, that the Minuteness of the Action surpassed your Faculties: If we consider, I say, that there is no Particle of Matter so little, since it is a Thing solidly extended into Length, Breadth, and Thickness, which doth not consist of other less Parts, and these of others, till we are quite lost in the Conception; we must own that this subtile Action of Cohesion descends still with undiminished Force: So that the very solid Extension of Matter, that is, the very Existence of it, is the indefinent Effect of *Divine Power*.

M. O *Philon!* the wonderful Action! I see almost with my Eyes, that the constant Exer-

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tion of the Power of the Deity is the very *Baſis* (if I might ſo ſpeak,) of the Exiſtence of Matter. I now ſee, what great Reaſon you had for ſaying, at the Beginning of our ſecond Conference, that no Man ever had, nor ever will have, a Notion of the Subſtance of Matter, otherwiſe than as the Power of the Deity is conſtantly exerted upon it; or rather, *exerted in it*.

LVI. *P.* If you reflect a little, you will perceive the other Sort of Attraction no leſs wonderful in ſeveral Reſpects.

M. I find it difficult to recall my Thoughts ſo ſoon, to the Conſideration of another Subject.

P. As the Attraction of Coheſion ſhews the various and inconceivable Power of the Deity, wherever Matter is; ſo the Attraction of Gravitation ſhews the ſame Power no leſs various and inconceivable, even where it is not.

M. Make this a little plainer.

P. You inferred rightly before, that the Attraction of Gravitation muſt prevail through the whole Planetary Syſtem, becauſe if our Earth (or any of the Planets) came to a Place where there was Attraction to no Center, its Courſe would be diſturbed, or it would ſeem to be deſerted. You obſerved, that ſuch a World as this required Tranſparency and Clearneſs, that the Light might not be intercepted, nor the celeſtial Bodies darkened, by Matter lying ſcattered at Random, or uſeleſs and unimployed in the Syſtem. Hence you concluded

ed that this Attraction of Gravitation was not only the Cement of particular Bodies, but of the whole Universe. The fourth Conference.

M. I see it must be so indeed; the Action must be propagated through the whole intermediate Space. This is astonishing; and I ought to have seen it before.

P. There is a Particular here which makes it still more astonishing, though you cannot yet understand it: For the Intensity of the Action is different at every different Distance, through the whole Space lying between the attracting Bodies.

M. I remember you said, the Attraction of the Sun on each of the Planets was different, which required a different Degree of projectile Force to be impressed on every one of them.

P. Consider then *any one Particle* of dead Matter in the planetary World, as attracting *every other Particle*; and endeavour to conceive in your Mind how various and wonderful the Action of *this one Particle*, or the Power exerted with respect to it, must be.

M. Alas, *Philon!* This confounds the Force of Imagination a thousand Times. A small Part of such Diversity would be more admired, because better understood. I now see that the Multiplicity of the Action as much overpowers our Faculties in this Case, as the Subtility of it did in the former. But indeed one's Amazement is divided; and which ever of the two any one considers at the Time, he must

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think that the moſt wonderful. The Mind of Man is too narrow for theſe Things.

P. After this think a little whether the infinitely various Action of *this ſingle Particle* could be the Action of other Matter upon it.

M. One who has the View, *Philon*, which I have at preſent, can hardly think on that Suppoſition with Patience. If we conſider that this is the Condition not of one ſingle Particle of Matter, but of *every Particle*; to ſuppoſe that all this is the Effect of other Matter acting upon them; is to imagine that there is infinitely more of *this other inſtrumental Matter* in the Univerſe, than of the Matter which it is ſuppoſed to move and actuate. This is a ſtill more inartificial and round-about Way, than the *ſubtile incumbent Matter* in the former Caſe. If nothing but the Action of Matter upon Matter will ſerve, what is it that moves this *other inſtrumental Matter?* Or where will the Inſtrumentality and Subordination of Matter to Matter end? This is to put the Deity quite out of Sight.

P. Leaving therefore theſe infinitely various, interfering, oppoſite Actions, propagated without Confuſion or Diſorder, through the Immenſity of Space, from every Particle to every Particle, as the proper Work of *Divine Power*; conſider in the laſt Place, that the Action of Matter upon Matter can only be according to the external Surface, and in Proportion to the Extent of that Surface; But Attraction operates

in

in Proportion to the Solidity of Matter; that is, it operates *from*, and *through* the whole internal Substance of Matter. The fourth Conference.

M. I see plainly that if Matter acted thus on Matter, neither the Matter acted upon, nor the Matter that impelled, could be solid or impervious to other Matter. This is the Work of the same Being, and of the same wonderful Kind, as Cohesion was discovered to be just before.——

P. These, *Matho*, are some Considerations concerning the Nature of Matter in general, which shew us the mighty Power of the Creator constantly exerted in all Objects above, below, and round us: Nor do they require any deep Learning to be understood, nor other Preparation than common Sense, and an unprejudiced Mind. As for Particulars you must have Recourse to those who have applied to the several Branches of natural Knowledge, and obliged the World with their Discoveries.

M. I am now indeed satisfied that we can neither turn our Eyes nor our Thoughts to any one Object in all Nature, where the Power of the Deity is not the first, or to speak more truly, the only Thing that occurs to us. The Thought is awful and ravishing!——You concluded lately that *the Particles of Light* were Matter or Body, because they excited Heat and Motion in other Bodies: Pray acquaint me with something of their Nature.

P. I can give you but small Assistance here, nevertheless it would not be well on my Part

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not to tell you all I know, which may be done in few Words.——They are the ſubtileſt Matter we know, and have the ſwifteſt Motion: But ſtill they are Matter, attracted and repelled by other Matter, and have their Motion bent and reflected, as much as a Tennis-ball.

M. It is but reaſonable that the Matter, by which *Viſion* is performed, ſhould be extremely ſubtile: Viſion, I think, is the moſt ſubtile of our Senſes; and groſs or palpable Matter muſt both hurt the Senſe and darken the Object; or the Light itſelf would be ſeen and not the Object it fell upon. But what may the Velocity of the Motion of Light be?

P. From the Eclipſes of the Satellites of *Jupiter*, it is computed that Light comes from the Sun to the Earth in about eight or ten Minutes.

M. I believe I need not ſtudy to conceive this Velocity from any Compariſon.

P. You need not: the Swiftneſs of the Earth's annual Motion, which you admired ſo much, does not at all come near it.

M. How is the Motion of Light bent or changed?

P. If Light were not reflected from Bodies, you could ſee nothing.

M. I ought to have remembered that the Sun-beams are eaſily turned to all the Corners of the Room by a Mirrour. And now that I think on it, if the Paſſage of Light were not bent,

bent, I could not see Objects monstrously distorted through uneven Glass.

P. In that Case, when the Ray is refracted or bent, you think the Object is in the Direction of that Part of the Ray which enters your Eye; though the Part of the Ray which falls on the Glass is in another Direction. This makes the Object seem to change its Place, or disjoins the Parts of it.

M. This solves many Doubts to me, which I shall not trouble you with observing.

P. The Rays of Light, in passing by the Edges of Bodies, are likewise bent or attracted towards them, though this can only be observed in certain delicate Circumstances.

M. This seems to explain to me a Thing which I have often admired. In going by *Paling* or *Rails*, all of parallel Sticks, you will perceive both the Paling and the Objects at a Distance behind it to tremble or dance as it were. I have walked backward and forward for half an Hour together to consider this. Now I suppose this is, because the Eye passing through these bent Rays near the Sides of the Sticks, and coming immediately to other Rays not bent, sees the Object suddenly change Place, and the Whole by this Means to have a tremulous or dancing like Motion.

P. You explain the Appearance very ingeniously and truly too in my Opinion.

M. If Light requires Time to move from Place to Place, if the Body it comes from be far distant, and also move swiftly, we cannot

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ſee it in the real Place: For while the Light is a coming to us, the Object may have moved a great Way.

P. You are in the right: and there is an Argument brought from this to ſhew the Abſurdity of the Ptolemaick Hypotheſis, where the whole Heavens are ſuppoſed to turn round in four and twenty Hours. For if we ſuppoſe the Diſtance of a fixt Star only ſeventy or eighty Times greater than the Sun's, ſo that the Light ſhould take twelve Hours in coming from the Star to us; it ſhould be ſeen ſetting in the Weſt, while in Reality it were riſing in the Eaſt, and contrarily.

M. That would be a monſtrous Inconvenience: The Motion of no Body therefore can bear any Proportion to the Velocity of Light, leſt we ſhould be conſtantly deceived in the Place of moving Bodies.

P. It is reaſonable to think ſo.

M. What is the Reaſon why Bodies are of different Colours, when Light is all of one Colour.

P. You preſs me too hard: Light is not all of one Colour, when the Rays are ſeparated, which may be eaſily done according to their different Degree of Refrangibility (as it is called) they are found to be of different Colours, as *red*, *orange*, *yellow*, *green*, *blue*, &c. and a ſcarlet Ribbon, for Inſtance, reflects the red Rays moſt ſtrongly; but what the Reaſon of this may be I cannot tell.

M. I

M. I believe indeed the Rays must be of those Colours from what I see in the Rainbow.——But not to trouble you more on this Head, answer me only one other Question. Pray what Sort of Men were those *Scepticks* whom you mentioned once or twice in our Discourse? The fourth Conference.

P. They were a Sort of Philosophers, whose Principle it was to doubt of every Thing.

M. Did they make a Principle of it?

P. They did; for any one undeniable Truth must have confuted their whole Scheme.

M. Then I presume they must have been much put to it in some Cases: You shewed me an Instance or two above, where doubting seemed to me impossible. What Reason could they give for doubting that *the Part was less than the Whole?*

P. They avoided coming to such Particulars.

M. Had they no Pretence for this affected Singularity?

P. They pretended there were contrary and equal Reasons *for* and *against* every Thing that could be affirmed.

M. Were they certain of this?

P. That had been to affirm something contrary to their Principle.

M. They could not be certain then whether they had Reason to doubt, or not.

P. They were not agreed on what Principle to found their universal Doubting, and therefore were divided into three or four Denominations.

M. Were

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M. Were Doubters so stiff in Opinion?

P. The Honour of their *Sect* obliged them to it.

M. I have enough of them *. And now, *Philon*, with your Permission, I would go and consider by myself what we have been discoursing of, that I may not give you the Trouble to tell me the same Things over again, when I come next to you.

P. That is not your Way; you rather improve upon what is told you. But perhaps we should speak more to the Purpose if we spoke less at a Time.

* We may see the Genius of Scepticism humorously represented in a few Sentences of a Letter of *Henry Stephens*, before the *Leipsick* Edition of *Sext. Empiricus.* 1718.—*An ex animo, et ut sentis, ita loqueris? Ingenuéque verum fateris?* The Answer is, ὃ μᾶλλον τοῦτο ἢ ἐκεῖνο. *Hic Libellus seriáne tractat, an nugas?* ἐπέχω. *Ad hæc saltem responde: Estne Philosophicum ejus argumentum?* ὃ καταλαμβάνω. *Age, quid definitum constitutúmque tibi de illo Libello est?* οὐδὲν ὁρίζω. *At mihi tuam de illo sententiam, quæcunque est, aperi? Imo nulla mihi sententia est, utpote nihil opinanti. Quid facis igitur?* σκεπτόμενος διατελῶ, *&c.*

THE

THE Fifth CONFERENCE.

The Consequences of the inactivity of Matter consider'd with Respect to the Productions in, and about our Earth.—Matter owes its Origin to an immaterial Being. The simple Existence of material Substance shews the infinite Power, *and the various Species of Things formed out of it, the* Wisdom *and* Goodness *of this Being. That any Sort of Matter we know hath passed through divers Operations, and various Art, before it falls within our Knowledge. The imperceptible Translations from dead Matter to vegetating Bodies. From the most imperfect* Plant *to* Man, *Vegetables and Animals rise in a continued* Scale *of Perfection. Propagation of Plants and Animals by Seeds, not mechanical: Or the Seed not the Cause of the future Plant, nor the former Plant of the Seed. The one appointed to follow the other, in order to constitute a settled Course of Nature. Hence an* eternal Succession of Causes and Effects, *a groundless and unphilosophical Supposition. The mutual Aptitudes, Relations, and Connexions between the Parts of the* Scale, *shew the Unity of Design. This shewn in the Article of* Food. *Of the successive* Evolution *of Bodies, in the Formation of many Species of winged Insects. That all these*

these inferior Creatures operate blindly, and yet regularly; or are directed by a Principle, more perfect than the Reason of Mankind. Monstrous Productions occasioned by Accidents, disturbing the regular Process in the Formation of animal Bodies, according to the settled Course of Nature.

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LVII. *P.* WHAT is the Meaning of this Visit, *Matho*, sooner than ordinary? For though I am always glad of your Company, I did not expect to see you for some Days.

M. I understand, from what you said before we parted last, that the Inactivity of Matter must have other Consequences, besides those we then considered; and I was impatient to be informed of them more particularly.

P. What other Consequences do you mean?

M. There is a great Variety of particular Bodies, in and about our Earth, which are formed out of this *dead Substance*; now the Consideration of these can be no less delightful and entertaining, than that of the great Bodies of the Universe. And it seems to me absurd, to neglect the Instances of Power and Wisdom that are near and round us; and only to take Notice of those that are so far distant as the Heavens.

P. Well, what are your Thoughts of Matter, after you have considered it still more narrowly?

M. You

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M. You know I began to suspect Matter after our first Conference: But before you shewed me so fully, at our last Meeting, the Nature of *Cohesion*, I still thought Matter stood in Need of no Support from any Thing else, to be what it is; that it owed its Origin to no Cause, was necessary in itself, and above the Reach of any Power, to be by that deprived of Existence. Now, I find, I was under a grievous Mistake in this whole Affair; and believe all young People fall naturally into the same Prejudice; though nothing, in my Judgment, concerns us more nearly, than to be early convinced, that the Course of Nature, and Stability of Things, must rest upon another Foundation.

P. On what other Foundation?

M. On the *Power* and *Government* of an *Almighty Being*, which affords a better Prospect, and more Security to Mortals, than such a dead Substance.

P. Might not this visible Frame of Things have existed always, and without any Cause, either to govern, or give it Origin?

M. After what has been said, it is perfectly superfluous to ask that Question. The rude Substance itself, not wrought up into any Form, nor diversified by any Art, stands in need of a constant Support, that it may exist in *any Manner*; and farther requires an Almighty Artist, not less skillful, than powerful, to make out of it such a beautiful Fabrick as we behold. I should sooner believe a Man, who

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who was to tell me, that *Iron* firſt made itſelf, and after that, faſhioned all thoſe curious Pieces of Art which are wrought from that Metal; than one who told me, that this viſible Frame of the Univerſe is not the Work of a Powerful and Wiſe Cauſe. *What ſtands in need of a conſtant Support from another Cauſe, that it may exiſt any Way, ſtood in need of the Power of that Cauſe, to give it Exiſtence at firſt.*

P. Your Argument is of the right Sort, *Matho*, and carries along with it all the Evidence of an Axiom. That only can be without a Beginning, which cannot poſſibly have a Cauſe; a Being, to wit, of infinite Power and Knowledge: Contrarily, therefore, a Thing which cannot be without a Cauſe, and is void of all Perfection, muſt have had a Beginning. And ſuch a Subſtance is dead Matter. Theſe are the two moſt oppoſite Things to each other, we can imagine. Hence, if this rude and unwrought Subſtance ſhews us, by its bare Exiſtence, the wondrous, extenſive Power of the Creator; the Variety of Things that are faſhioned out of it, their Uſe, and Application to ſomething always higher, muſt equally convince us of his Knowledge and Wiſdom. Nothing is wanting to complete the *mighty Deſign*; and thoſe Things, which we might think ſuperfluous, are ſtill neceſſary to the intended Variety, and to carry up the *Scale* of created Beings. For this Variety is not propoſed for Oſtentation of Power; that would be a falſe Thought; but

to

to finish consistently a great and harmonious Scheme.

M. To whom should the Deity make Ostentation of his Power? That would be, to suppose Beings capable to understand and fathom the greatest Things he could perform. This Variety must have a higher End. Every Thing rather shews Infinity of Power, conducted by infinite Wisdom.

P. And those set on Work, likewise, by the most disinterested Goodness. These Perfections are not only necessarily united in their Nature, but united also in the Effects they produce.

M. It must be so: If they were separated in the Effects they produce, it would come to the same Thing, as if they belonged to separate Beings, if that were possible; and the Effects of Power might be hurtful. I saw before that a sovereign Degree of Power and Knowledge must naturally raise a Being above *Fear* or *Malice:* So that *Goodness* must be the Motive, when infinite Power and Knowledge work; or, without this Motive, the Universe could never have existed.

P. Let us remember then, what was concluded before; namely, *That the very Resistance of Matter to perform any Effect, is made the Means of its doing all it performs*; and we must be satisfied that the Wisdom and Power, and therefore the Kindness of the Deity, could not have been more conspicuous any other Way, than by employing to such a Variety of

Purposes

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Purpoſes a Thing, which, in itſelf, or to a Being of leſs Power, is unfit for any Purpoſe.

M. This Variety, even an unſkilful Spectator muſt admire, by beholding the Outſides only of the Works of Nature: He can direct his View no where, but he muſt behold Things great, curious, and beautiful, made out of this unpromiſing Subſtance. It ſhines and warms, it cools and refreſhes, it is made Light to the Eye, Sound to the Ear, and by a wonderful Contrivance, nouriſhes and maintains our Bodies.

P. The Uſefulneſs of it, therefore, is equal to the Variety: And this is that, *Matho*, which hath brought it into ſuch Admiration, and really made it the Deity of Mankind. For while it is made to recruit the Decays of our Bodies, and gratify every Senſe, by the noble Appearance, the beautiful Colour, the fragrant Smell, or delicious Taſte; we do not conſider the Power and Contrivance by which all this is effected. We forget to carry our Views to the juſt Extent; for certainly, nothing could have been better fitted, to give us the firſt Leſſons concerning the Power and Wiſdom of the Creator, than to conſider the Poorneſs of the Stuff every where heightened by Art, and made uſeful in the Application. The very Deadneſs and Inactivity of Matter is diſguiſed by the Power that actuates it, and lyes concealed under a thouſand Beauties of Life and Vegetation. Nor can we poſſibly be miſtaken about it, ſince we ſee it again in its

its fading and corrupted State. What does the finest Complexion, or the most beautiful Flower, soon end in?

LVIII. *M.* It is the Usefulness, the Variety, and the Contrivance of those Things round us, which we daily behold with so much Inattention, which I would have you explain to me at present; that for the future I may behold them with some Sort of Intelligence and rational Pleasure. It is either stupid, or shameful, for a rational Being to walk constantly amidst such Instances of Contrivance and Power, with the Indifference or Insensibility of an unreflecting Animal. This, as I said, was what hastened my Return, sooner than you expected.

P. Willingly, *Matho*, would I assist you in such a reasonable Design, if I knew where to begin, or were not afraid of obscuring these Matters, by the confused Hints only which I am able to give you. Therefore, as I told you, when we last parted, you must have Recourse to the Works of those great Men, who have successfully enquired into Nature. The Subject here is not one, but as many as there are different Species of natural Bodies: Each of which require a separate Study, to understand but a Part of the Art and Contrivance employed in it; nor have these Things been treated with that Connexion and Dependance one on another, so as to bring them under one general View.

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M. We need not be ſolicitous about a Method, ſince none can be obſerved in ſuch a Converſation as this: I only want to be directed to the moſt general Conſiderations, that I may have ſomething to exerciſe my Thoughts upon, when, perhaps, I ſhould otherwiſe be idle.———Pray what did you mean, juſt now, when you ſaid that this great Variety is neceſſary to carry up the *Scale* of created Beings?

P. Every Thing, *Matho*, above rude and unwrought Matter, riſes in Art and Contrivance, the farther we advance, or the higher we can go. Many are the Productions, before we come to the ſeveral Species of *Plants* and *Animals*; of which there is an amazing Variety: And yet there is a Gradation of Perfection from *Kind* to *Kind*, through the whole, where every Species is raiſed above the former, by gentle and eaſy Tranſitions. Thus a *continued Relation* runs through the entire Syſtem of material Beings (or rather through the whole Creation) which joins the *leaſt* with the *greateſt*, and ſhews the whole Work to be *one*, and the Effect of the ſame Power and Knowledge.

M. I ſuppoſe you mean, that in ſome Species of Plants and Animals the Art is more acceſſible and ſimple; but in the next ſuperior Kind the ſame Art is continued, and farther heightened with ſome Additions or Variations, as it were to lead us from the more ſimple to the more complex Works of Power and Knowledge.

P. You

P. You expreſs my Meaning exactly.

M. This is both pleaſant and intelligible, and juſtifies, I think, the Inference you make, *That the whole Work is one, and the Deſign of the ſame Power and Wiſdom.* For I eaſily conceive that an *Earth-Worm* is more ſimple in its Parts and Compoſition, than a *Snail*, which carries its Covering or Houſe on its Back, and hath Eyes in the Points of it's Horns, as I have heard; and that this Creature is not ſo complex as a *Spider* or *Ant*, who move by the Help of Feet, and have a Variety of Limbs; and that theſe Inſects again are more ſimple in Contrivance than a *Fly* or *Gnat*, who, beſides their Motion by Feet, have alſo Wings to ſoar aloft.

P. You have named ſome of the Wonders of the inferior Creation, *Matho*, and ſpeak ſo diſtinctly of thoſe Things, that one would think you had been making your Obſervations before-hand. If it be doubtful whether the Snail hath Eyes in the Points of its Horns, it is certain the *Spider* hath ſeveral Pair of them: And the different Sorts of Motion in theſe Creatures, with the different Artifice by which they are effected, will always excite our Admiration.

M. Theſe Objects fall generally under our Obſervation, and they require but little Reflection. But pray what Productions are there before we come to the Species of Plants; or which lye betwixt theſe and unwrought Matter?

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P. The first Thing we perceive in this Substance is Workmanship; therefore we cannot in Propriety say that a Stone of any Sort is unwrought Matter. No Body could imagine that a Ruby, an Emerald, a Diamond, or any of those Stones that are called *Gems*; or that a Magnet, Marble, Flint, or so much as a common Pebble, is rude and unwrought Matter. If we consider Crystal, Amber, all Sorts of Minerals and Metals; Salts of all Kinds; none of these certainly is Matter in its primogenial Form and Texture.

M. They are not indeed; but must have undergone farther Art and Workmanship, before they could appear in any of those Forms.

P. Though we know not exactly how these are produced, yet Productions they are; and (as you say) various Art and Power is exercised on every different Species of these, as much as on the Stone of a Cherry, the Tooth of an Elephant, or the Horn of an Animal, concerning the formal Production of which we are very little wiser. Water itself, dropping from the Roof of some Caves, is soon after congealed into Stone. Marble was once not hard, otherwise Parts of different Bodies could not have been found in it. You observed before a Variety of Substances formed in the animal Body; Bones, Sinews, Flesh, Blood, and not rarely one Sort of Stone; all which are yet made out of the same common Aliment.

M. I am entirely satisfied in this Particular. Matter, that had undergone no Workmanship, must

must be conceived to be uniform and all alike, without Variety of Impression, or different Degrees of Firmness, Cohesion, or Consistency, such as we saw it to be when the *great Bodies* of the Universe were formed. All farther Difference must be the Effect of farther Power and Art. The fifth Conference.

P. It must be so; for all Growth and Vegetation, even of the hardest Substances, is performed by the new Accretion of imperceptibly small Particles: And these Substances are again dissolved into Particles as minute and imperceptible.

M. You shewed me before, that we could form no Conception of Matter, but as the Power of the Creator is exercised in it, to effect Cohesion and solid Extension; for that constant Action is the Basis of its Existence: And here I perceive again it could not fall under the Senses, unless the same Power were farther exercised upon these Particles, to bring them by another Act within the Reach of sensible Perception. And certainly this is wonderful that, let us consider Matter which Way soever we will, we meet always with the Power of the Deity; and the more Ways it becomes known to us, the more Acts of that Power we discover.

P. Your Reflection is pertinent, *Matho*, and it must be as you say. If we could consider the Deity in himself, and abstractedly from what he hath produced (as we attempted in our last Conference) we should find his Na-

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ture and Perfections neceſſary and infinite, and be every where prevented with the Sight of them: And when we conſider his Effects aright, we muſt find his Power and Knowledge in every Thing, examine it which Way we will.

LIX. *M.* The ſeveral Species of Things you have mentioned are formed within the Bowels of the Earth.

P. Or at leaſt below its Surface; and though they are not produced from Seeds, like Vegetables above Ground, yet ſome of them come near enough to ſhew almoſt the ſame Work in different Subſtances. One Species of thoſe Stones, called (I think) *Stalactites*, in Shape like the ſlender Stem of a young Plant, broke any where up or down, hath always the ſame Star-like Figure or Impreſſion in the Heart; as when you cut a Plant above or below, the Fibres make ſtill the ſame Appearance in the Section. The ſame is obſerved in the ſeveral Sorts of *Coral*, which ſeems to be of a middle Nature indeed, between a Plant and a Stone.——

M. Permit me to aſk you what is contained within the Bowels of the Earth; or is it known what the whole Maſs down to the Center conſiſts of?

P. It is not known: The deepeſt *Mines* go but a ſmall Way below the Surface, and after that all is Conjecture.

M. We

M. We cannot know then what this Globe we live upon contains for four thousand Miles down.——What do they find in the Mines?

P. Different Sorts of *Earth*, *Stone*, *Coal*, &c. lying in *Strata*, one over another, with here and there the *Ores* of Metals.

M. These are not Matter in its original Form.——What Sort of Matter do they conjecture to be from that to the Center?

P. They suppose that the solid Crust of the Earth is not very deep; and some have thought that the internal Part is a subterranean Ocean, while others imagine that there is a vast Mass of Fire about the Center. It hath been supposed, in order to account for a difficult Appearance in Philosophy, and to avoid the Thought of so much dead Matter, that the internal Part of the Earth consists of *vacant Spaces* and *Crusts* alternately.

M. These Conjectures are opposite enough, so that the Probability for any one of them must be an Argument against the rest.

P. This is but one Particular of many, which lye without our Reach.

M. Leaving it then, you seem to think that all Vegetables above Ground rise from Seeds?

P. That was long Matter of Enquiry and Dispute; but it is now allowed to be true in all Cases universally.

M. Why was it Matter of Dispute?

P. If a Plant could rise from any but a specifick Seed, then it might be contended that any Thing could rise from any Thing,

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which must have bad Consequences in Philosophy.

M. I understand; it is supposed that these *specifick Seeds* keep the Species regular.

P. This is the constant Experience of Mankind: A *Fir-Tree* does not rise from an *Acorn*, nor a Crop of *Wheat* where *Barley* was sown.

M. That would certainly breed the last Degree of Confusion and Distress to Mankind; and we cannot sufficiently adore that Wisdom which hath ordered Things otherwise. Yet I have seen the Root of an old Tree, where the Trunk had been cut off, quite covered with Excrescences, different from *Mushrooms* or *Toad-Stools*, with a Variety of pretty bright Colours. These certainly vegetate, and yet they have neither *Flower*, nor *Fruit*, nor *Seed*; but seem to spring up from the Corruption of the decaying Wood.

P. The first Degree of Vegetation, *Matho*, is so fine that it is hard to trace it out, though above Ground. You know we are soon lost in the Subtility of Nature's Operations. Hence it is that some Species of imperfect Vegetables impose upon the Inattentive, and pass for mere anomalous Excrescencies, though they are nothing less. The Species of *Fungi* (as they are called) are very numerous: It was one Sort of those which you observed. The Structure of some Kinds of them is altogether curious, as you must have seen: And the diligent Enquirers into Nature have at length discovered that they

they rise from a Seed, and are not spontaneous Productions from decayed Wood, or any Sort of Corruption, though they draw their Nourishment from such Things.

M. I have indeed observed some of the broader Sort, with flat thin Caps, finely wrought below, having a slender Kind of Leaves, running very regularly from the Middle to the Extremity, like the Rays of a Circle: But these Seeds must be very small, which require such Attention to be discovered.

P. This is not the only Instance where the first Degree of Vegetation runs almost beyond our Ken. Where-ever the Seeds were not perceptible to the naked Eye, the Ancients supposed the Productions from them spontaneous and irregular: But the Invention of the *Microscope* has enabled the modern Enquirers to make noble Discoveries in the Works of Nature, though still the Subtilty of the Contrivance goes deeper than the Industry of Man can penetrate. So small are those Seeds, that it is to be doubted whether many Sorts of them are not constantly wafted up and down in the Air; since they so quickly take Root, and spring where-ever they can find a Soil delicate enough. For it has been discovered by the Microscope, that the Mouldiness which appears on spoilt Confections, Pickles, or even some Sorts of Liquors, by which they appear as if covered with a white Crust, are only numerous Clusters of diminutive Mushrooms.

M. This

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M. This is really ſurprizing, and carries the Beginnings of Vegetation almoſt out of our Sight indeed. What you ſay of a white Cruſt puts me in mind of another Particular I have often obſerved, and endeavoured to account for to myſelf, though in vain. Pray what are we to think of the ſeveral *coloured Cruſts* which we find on Stones, and the Bark of Trees? On the ſame Stone, or the Bark of the ſame Tree, you will ſee Spots of *white Cruſt*, of *black*, of *grayiſh*, and very often of *yellow*. At firſt they are very hard, and ſeem little other than a Colour inherent in the Stone; afterward they ſwell and riſe.

P. Theſe, *Matho*, are ſeveral Sorts of *Moſſes*, which you may know by their different Growths: For if you obſerve on the ſame, or different Stones, you will ſee the ſame Sort young and hard, more advanced, and at laſt ſpread, when their ſeveral Figures are eaſily diſtinguiſhable by the naked Eye. Some ſpread in a continued Leaf, others grow hollow above like ſmall Cups, others round on the Top like Muſhrooms, and ſome ſhoot out in Branches.

M. It is ſo indeed; theſe Varieties, and many others I have often obſerved with great Admiration: For I remember this was the firſt Thing that raiſed my Curioſity.

P. All theſe have their different Seeds, which do not require great Delicacy of Soil, but take root on any Thing where they can grow unmoleſted. Thoſe *Moſſes* which riſe

immediately from the Earth, are more perfect, some of them white, and hollow, or fistulous, and some of them not much inferior to regular Plants. The fifth Conference.

M. There are much perfecter Sorts which grow likewise on Stones, in the Form of a fine Pile or Furr, like Velvet, and of a glossy Colour between green and black. But the first Sort, which appears like Scurf or Crust, seems to rise but one Degree above the unwrought Mold or Earth.

P. Yet we are far from being certain that this is the lowest Degree of Vegetation.

M. Those Mosses growing on Trees shew, I think, that their Seeds must fly about in the Air.

P. We shall become too minute at this rate, *Matho:* However, what you say is more than bare Conjecture: For some Experiments shew that living Creatures themselves float thus up and down in that Element. An unhealthy Tree is never without these imperfect *Superplants*; and the more unhealthy the Tree is, the better they thrive.

M. It seems, as some Animals can only live on other Animals, and have not a separate Way of supporting themselves; so some imperfect Vegetables can only thrive on other Vegetables.

P. There is some Analogy between the inferior Vegetables and Animals in this respect: And there is (if I might so say) a studied Variety through all Nature: But some much perfecter

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perfecter Plants than Moſſes can only take Root on a Tree. You certainly remember theſe Lines.

Quale ſolet ſylvis brumali frigore viſcum
Fronde virere nova——
——quod non ſua ſeminat arbos,——

I was told of the *Miſletoe* at that Paſſage. However,

LX. One Thing you ſaid above ſurpriſes me more, *viz.* That any Vegetable ſhould take Root in mere Liquor, as thoſe little Muſhrooms you ſpoke of.

P. The Fact is nevertheleſs unqueſtionable: Two or three Sorts of Plants ſtrike their Roots in the Water, without touching the Ground at all; and, as a Proof of this, they float to and fro on the Pools where they grow.

M. This is a ſingular Inſtance of Variety.

P. As many Species of Animals can only live in the Waters, ſo many Sorts of Plants can only thrive in that Element, though their Roots are fixt at the Bottom; and of thoſe ſome never riſe to the open Air. Some Kinds of Plants alſo, as well as Animals, are amphibious, and can live either in or out of the Waters.

M. By the Weeds caſt out on the Sea-Side, the ſalt Water ſeems likewiſe to have it's peculiar Vegetables.

P. And that in great Variety; nor ſuch only as deſerve the Name of *Alga*, but Shrubs and larger Trees, with ſome of which near the Iſland

Island of *Crete* they used to dye Purple. *Pliny* tells us, that in the *Indian* and *Red-Sea* are whole sub-marine Woods.

In the *Persian* and *Red-Sea*, and many other Parts, Coral is produced, of which we spoke before. Under Water it is soft, but petrifies in the Air. But the Nature of marine Plants is not so well known, as those on the dry Part of the Globe; as not being so accessible, nor to be trained up in different Circumstances.

M. Hence, I suppose, the greatest Variety must be on dry Land, where there is a greater Difference of Soils.

P. You see the whole Face of the Earth is covered with them, as with a large and costly Carpet.

M. The Carpet is very large indeed! and a new one spread every Year with more Variety of Figures and Colours than the *Loom* or *Needle* can boast. We do not think enough on these Things. A bare and naked Earth must have an unpleasant Sight.

P. Not more unpleasant to the Eye, than unfit for Habitation. We might have lived as comfortably on a Globe of Marble, as on such a naked and barren Globe. We observed before, that the Disposition of the Surface into Hills and Valleys was for the sake of sweet and running Waters, which only regarded the Animals and Vegetables upon the Earth. The Sea itself, that huge Magazine of Waters, was chiefly intended for the dry Part of the Globe; though at the same Time it serves for many other

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other wonderful Uſes, and is beſides a mighty Nurſery of living Creatures. Hence it is, ſince this *Element* is ſo abſolutely neceſſary for Animal-life and Vegetation, that it bears ſo great a Proportion to the dry Land. Some Philoſophers likewiſe, with a great Degree of Probability, ſuppoſe, that this Article of Vegetation occaſions a conſtant Expence and Conſumption of Water. Which ſhews us, that this great Proportion of the liquid to the dry Part of the Earth was ſtill more wiſely appointed.

M. I have in Truth often wondered, on looking at a Map or a Globe, to ſee ſo much of the Surface of the Earth covered with Water: But this accounts for it naturally, or rather makes this Diſproportion between them neceſſary.——But pray let me aſk you here again, if it be known how deep the Sea is?

P. You may be ſure it cannot be all of the ſame Depth. Iſlands and Rocks are generally ſituated near the Coaſts of the larger Continents; which ſhews that the Sea is there but of a moderate, or rather ſmall Depth. In withdrawing from the Land it becomes unfathomable: Hence it is natural to ſuppoſe that in the midſt of the large Oceans, as the *Atlantick*, *Ethiopick*, *Pacifick*, and *Great South Sea*, the Depth is greateſt. But what the Diſtance of the Surface of the Water there from the Ground below may be, is not eaſy to be determined. There is not the ſame Reaſon for an equal Declivity from the Coaſts to the

the Middle of the Ocean, as from the Middle of the Continents to the Coasts: Yet possibly the Sea there may be some Miles deep. The fifth Conference.

M. Who hath hollowed out such a *mighty Bason*, and *filled* it with so useful a Fluid! All the great Rivers on the Earth themselves, like gliding Oceans, were constantly to be drawn from this vast Repository of Waters.

P. And drawn through the Air too, to the Tops of the highest Mountains, where they were to begin their Return over the Face of the thirsty Ground. And this Circulation was to be maintained through all Ages. The Vapours are raised by their specifick Lightness, and mutual Repulse; till coming to a colder Region, where their repellent Force is weakened, they are brought again into small Drops, which fall by their own Gravity. Whence we see that the whole terraqueous Globe, Sea as well as dry Land, taking in the whole Region of the Atmosphere, was contrived for the sake of Vegetation, as the first and immediate Use; though Vegetation itself is still referable to a higher Design. Upon this account it is that no Part of the dry Surface is vacant and unemployed. Not only the *Plains* and *Valleys* are delicately clothed, but the *wild Mountains* have their rougher vegetable Covering. Vegetation and Animal-life go together, and in the deep Winter languish together. The stately and noble Plants, which rear their Heads aloft, are perennial and long-lived, like some Animals; but more Sorts of both are of a short

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ſhort and tranſitory Duration. The *Inſects* revive with the Verdure of the Spring: Every Seaſon of the Year brings forth a new Variety: Every Soil and different Climate have their peculiar Species, both of Vegetables and living Creatures. As the Diverſity of the ſeveral Species is aſtoniſhing, ſo the Fecundity of the Individuals is no leſs ſo. Were all the Seeds of any of the moſt uſeful Plants employed annually for Vegetation, that alone in a ſmall Number of Years were enough to cover the whole Surface of the Globe. Learned Men have ſhewn the ſame with reſpect to many Animals, eſpecially in the Waters. But the Almighty Author of Proportion preſerves a juſt Balance, and diſpoſes the Superfœtation of his Creatures to neceſſary Purpoſes. The *Exuberance* ſhews his Power, and the *Application* his Wiſdom and Goodneſs——Theſe are only general Things, *Matho*, which it is eaſier for any one to admire in his own Thoughts, than to make worth another's while to hear. You ſee my Willingneſs; nor can any Words repreſent what an attentive Mind may eaſily obſerve. To ſay any more would but anticipate your Pleaſure.

M. You have rather given me a noble Proſpect, *Philon*, of the Productions in and about our Habitation. The Bowels of the Earth ſeem to be a vaſt *Laboratory*; the Surface of it is wrought into a beautiful and ſpacious *Garden*; the Ocean its *Fountain*, and (if I durſt go farther) the Air a mighty *watering Engine*.

If

If we look above and below Ground, the ſame common Matter is formed into ſuch a Diverſity of Bodies, as if they were wrought from Subſtances of contrary Natures. A Plant and a Mineral, or Metal and an animal Body, or (to come yet nearer) the Stone and the Fleſh of the ſame Peach, ſeem not to be Matter in the ſame Senſe. But aſſure yourſelf we are far from having done. I have many Queſtions to aſk; every Thing you ſay raiſes new Thoughts in my Mind, and one Particular above I either did not underſtand, or am not ſatisfied with.

LXI. *P.* What may that be?

M. I believe no young Perſon of ten thouſand ever ſaw a Field of Corn grow, without admiring the Miracle of Propagation from Seed, and that inconceivable *Fecundity of Individuals* which you mentioned juſt now. This is one of thoſe Things which firſt ſtrike the young and inquiſitive Mind with Wonder; and how the regular Obſervation of the Species is owing to the Seeds of Things I do not yet underſtand: But I ſhall proceed to aſk you my Queſtions by Degrees.——If one ſingle Grain of *Wheat*, or any other Seed, were ſown, and the Product of it preſerved and ſown; and the Product of that again preſerved, and ſown, and ſo on; how far do you think it would multiply? Or would there be any End of its Increaſe?

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P. According to the Courſe of Nature, we have no Reaſon to think it would ever ceaſe to multiply.

M. So I have often thought; and according to what you ſaid, it muſt in Time be ſufficient to cover the whole Face of the Globe. Now how comes this infinite Number of Plants and Seeds all to ſpring out of one ſmall Grain?

P. That is a Queſtion I can by no Means ſolve. It ſeems to me to carry the Subtilty of Vegetation far out of human Sight. And what heightens the Difficulty is, that the Seed, in ſome Caſes, is diſcovered to contain in Miniature the Plant that riſes from it, with ſo much Nouriſhment wrapt up in it, as may ſerve to its firſt Vegetation, till it can ſtrike Root in the Ground, and draw its farther Support from thence: And from this it is concluded that all its future Vegetation only nouriſhes and increaſes the Parts of this ſeminal Plant.

M. That Conſideration indeed makes the Propagation of ſuch an infinite Number of Plants and Seeds, all from one little Seed, above Meaſure aſtoniſhing. But what have the *Searchers* into the Myſteries of Nature thought of this?

P. It is really a *Myſtery*; however, ſome have had recourſe to the infinite Diviſibility of Matter to explain it, ſuppoſing that all the infinite Individuals of any Species, whether of Vegetables or Animals, were actually contained in the firſt original Seed.

M. And

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M. And how came this *infinitely impregnated original Seed* to exist?

P. You press me too far.

M. Since, according to the Course of Nature, the Propagation from any of these *propagated Seeds* is indefeasible, each of these must likewise be *infinitely impregnated?*

P. It must on this Supposition.

M. Did they rest satisfied with this Explication?

P. They could not, I think, otherwise than by having recourse to the constantly operating Power of an Almighty Being. And it is thus, in my Judgment, that the Origin of any Thing must lead our baffled Reason to seek a Solution of Difficulties in *Omnipotence.*

M. If we are forced to have recourse to the constant Operation of that Power, this Supposition seems needless. But is this all that has been said?

P. Others have supposed that the greatest Part of the *terrestrial Mass*, at least near the Surface, consists of the Seeds of Things, ready wrought up and perfected, which are impassible in all the Changes that happen, till they come, in the Course of Things, to be brought into the Circumstances of Growth and Vegetation: And that there is no more rude and unwrought Matter in the Mass, than what may serve for a Support to that which is designed for future Plants and Vegetables: for I am not sure if they include Animals in this Supposition.

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M. And yet if Animals be not included in it, they will have another Suppoſition to make for theſe, ſince there is the ſame Difficulty in both Caſes. Here it is not enough to ſuppoſe the Seeds of all Things finiſhed and wrought off at once, and repoſited any where: It muſt likewiſe require infinite Care and Direction, to produce theſe little impaſſible Seeds in their proper Time and Place, without Confuſion or Miſtake, according to the ſettled Law and Courſe of Nature, ſince they can do nothing of themſelves.

P. It is certainly ſo.

M. Though then there were ſuch *original immutable Atoms* repoſited, which contained the ſeminal Power, or were deſigned for the future Seed, yet when a Grain of *Barley*, for Inſtance, is ſown, and begins to ſpring up, what directs the *ſpecifick Atoms*, deſigned for that Seed, to it, rather than the *Atoms* deſigned for *Wheat*, *Rye*, *Oats*, or, in ſhort, for any other Grain? Or could the ſettled Courſe of Things be obſerved, if one Grain roſe where another was ſown?

P. As you obſerved before, that muſt breed the laſt Degree of Confuſion.

M. There are likewiſe many Things to be done, I preſume, after the firſt *ſpringing up*, before the future Seed is formed: For let us conſider a *Field of Corn*, a *Meadow*, an *Orchard*, or, in a Word, the whole Face of the Earth, as covered with Vegetables; and is not every Grain or Seed that riſes over the Whole, once

once in the Form of a green Blade or Leaf? The fifth Conference.

P. At first it is, or in the Form of something as different from the future Seed, as a green Blade is.

M. And after that, I presume, in other Forms still, as the Seed draws nearer to a perfect Formation?

P. It is indeed in the Form of *Sap*, or of a *Blossom*, or *Flower*, or *Milk:* For all the Particles are once, or rather always in a liquid Form, till the Seed comes to be hardened.

M. What Hand then, or whose Art brings this Seed, whether in one Atom, or separate Particles, through all these various Forms and Changes?

P. It is impossible to account for this, *Matho*, without the immediate Power of the Deity, since the sluggish Particles can neither move, nor assemble themselves from different Parts, nor fall into that constant Change or Order, which is requisite to their coming out at last in the designed Form, or so as to make up the specifick Seed.

M. If then the Power of the Deity must be immediately concerned in all this *various Work*, we need not, I conceive, be so anxious to find out, all at once, an original Stock of Seeds, to serve for future Vegetation through all Time.

P. In these Cases we find out a *Compend* for the Deity, only by our own Mistake; since after such Suppositions the indefinent Operations of his Power and Wisdom are still neces-

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sary. Matter is as much a dead resisting Substance in *Vegetation*, as in the Motions of the heavenly Bodies.

LXII. *M.* This likewise seems wonderful, That from the same *Mold*, and the same Sort of *Fluids* or *Juices* (as I suppose) so many different Sorts of Vegetables, and such different Kinds of Bodies on the same Vegetable should arise. In a small Spot of Ground you shall see a great Variety of *Herbs*, *Flowers*, *Trees*; and belonging to the same Tree a great Difference of Productions, *Leaves*, *Bark*, *Wood*, a *mellow Fruit*, a *hard Stone* within, or perhaps a *strong Shell* without. Has each of these Substances a different Seed? or will it be a satisfactory Explication, to say that the original Seed contains Leaves, Bark, *&c.* in itself.

P. Leaves and Bark are but excrementitious Parts of a Plant.

M. Yet they are as specifically different from the Leaves and Bark of another Plant, as the Wood, or Fruit, or Seed itself: Account for this specifical Difference of these Parts. You must either account for every Difference from the Seed, or give up the Pretence of accounting for any Thing from it.

P. Each Sort of Plant, they say, draws Juices proper only to its own Species.

M. What is meant by *drawing* here? In plain Language it seems to be as good as saying, *Each Sort of Plant forms itself.*——But when several Kinds of Trees may be grafted on

on the same *Stock*, they seem to have but one Kind of Juice to draw. And yet the Fruit of each Sort preserves the particular Colour, Taste, Smell; and the Leaves and Wood remain with the same Differences from others as before. What is said to this?

P. I know not whether any thing be said to it.

M. To say the *Stock* draws to itself the Seeds of every other Tree that might be grafted upon it, and bear Seed, would be to suppose that every Sort of Plant draws to itself the Seeds of all other Sorts. And unless we will take the Liberty of talking at this Rate, this Matter of Fact seems to shew that there are no such Seeds wrought off before Hand, and lying ready prepared; but that they are formed every Season, as much as the Fruit or Leaves.

P. That is the more tenable Opinion.——

M. And then, though several Sorts of Animals were fed with the same Species of Grain, or with Hay of the same Field; that would not make their Flesh taste all alike: Beef would not turn Mutton, nor Pork Fowl, in such a Case.

P. There are certain *secretory Glands*, which have the Orifices or Mouths of their Vessels so fitted, as to admit only such Particles for Nourishment as are of a particular Size, and proper or specifick for the Plant or Animal, or the Part of any of these which is to be nourished, and which therefore repell or throw off Particles of a different Size.

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M. Theſe Things are new to me, *Philon*; but I believe there muſt be ſuch Contrivances in the Animal-Body: Yet, if thoſe Glands are nothing but Matter, they can no more be the Cauſe of the ſpecifick Differences we are ſpeaking of, than an *Artiſt*'s Tools are the Cauſe of his Art, of which they are only the Inſtruments. There muſt be a higher Principle than *Orifices* and *Particles* of ſuch a determined Size. For if theſe Orifices, or the Texture of the Gland, be fitted to receive Particles of a larger Size, how are thoſe of a leſſer kept out? If to admit only Particles of a leſſer Size, how can theſe get in? Since the larger coming up along with them would naturally ſtop or obſtruct theſe Orifices. And if both Sorts come not up together, the *Secretion*, I think, was made before. And what is ſaid of the *Magnitude* of Particles, is true alſo concerning their *Figure:* Orifices or Paſſages deſigned for receiving Particles of one Sort of Figure, muſt be obſtructed by thoſe of another Figure, coming up along with them. —— Beſides, how come the various Particles thither? For as to *repelling*, or *throwing off*, which you mentioned, it is like the Plants *drawing* proper Juices to them. Attraction and Repulſe are not the Work of inert Particles. I remember you ſaid the Quantity of Motion once impreſſed is conſtantly decaying by the Action of Matter upon Matter. In this Caſe therefore the Impreſſion muſt be renewed on theſe Particles every Moment: Or rather, they muſt be conſtantly

constantly impelled, and that in various Directions, but not by the Power of Matter.

P. We are agreed, *Matho*, no Man ever had a Notion of Secretion purely mechanical. The admirable Structure of these Glands or Strainers, and of every other Part in the Animal-Body is only *instrumental*; but can no more supply the *Power* in a living, than in a dead Animal. The Mind of Man is ingenious to deceive itself. Seeing no other *Power* or *Direction* near at Hand, to which we can have recourse, we suppose that the Matter in the animal or vegetable Body must have all those Powers in itself, necessary to account for such wonderful Appearances. But the Growth and Vegetation of all Things round us (not to speak of the Work in the animal Body) is a constant, various, and infinite Miracle.

LXIII. *M.* This answers my Expectation, and agrees with what we have observed in the rest of Nature. But tell me, before we leave the Subject, why should such Stress be laid upon Vegetables rising from Seeds? Let the Seed contain the future Plant ever so exactly, yet when the Seed itself and the contained Plant are formed, they pass through various Changes, by a Power quite above that of sluggish Matter: They are wrought from different Substances, and often from the Sap and Juices of a Tree of another Nature. The Seed therefore contributes nothing at all to the regular Continuance of the Species of Plants

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Plants (and poſſibly I might ſay Animals) more than the Plant contributes to the regular Continuance of the Species of Seeds. The two Caſes ſeem exactly alike: Both Formations are the Effect of a different Cauſe; though the one is appointed [arbitrarily] to follow the other, as a ſettled Courſe of Nature.——

P. Since the Atheiſt contends that all Things ſpring up ſo ſpontaneouſly at firſt, and therefore that any Thing might riſe from any Thing; it is a Point of ſome Conſequence, *Matho*, to ſhew him that a Plant only can riſe from a ſpecifick Seed, and a Seed only can be produced from a Plant, even in the loweſt Vegetables. This is a conſtant Matter of Fact againſt him. But I am afraid the Generality of Men go too far, in ſuppoſing that the Regularity of the Species depends upon the Seed: Whereas you have ſhewn very well, that the future Plant no more depends upon the Seed, than that Seed depends upon the former Plant. The Argument, thus ſtated and cleared, ſhews that there could not have been an eternal Succeſſion of Seeds and Plants, nor of *Father* and *Son*, for the Caſe is the ſame. This alſo has been contended for, and called an *eternal Succeſſion of Cauſes and Effects*. The Seed is neither the Cauſe of the Plant, nor the Plant of the Seed. It was a true Obſervation which you made at your firſt coming in, " That the " Courſe of Nature, and Subtility of Things, " muſt reſt upon a ſurer Foundation than " dead

"dead Matter." In Reality a Plant is formed from various Parts of Matter *not a Plant*; and a Seed from various Parts of Matter *not a Seed*. This shews the absolute Power of the Creator over Matter, and that he is the immediate Cause of the Production in both Cases. But he hath appointed the one Production to follow the other alternately, that there may be a settled Course of Nature, and that Man may know what he has to do. In a Word, we reason but by Halves with the Atheist, when we shew him that all Vegetables rise from *specifick Seeds*, unless we likewise shew him that these Seeds are the immediate Work of *Almighty Power*. Without this, these Seeds have only the Appearance of *Moulds* and *Forms*, for the Atheist to direct his Work by, lest he should happen to blunder. The fifth Conference.

M. You have expressed this Affair to my Satisfaction.——And if after this we consider the *various Action* in the Growth and Vegetation of Bodies, by Parts only, or in the more simple Cases, and still rise from the Individuals to the Species, till we have taken in the whole vegetable Kingdom, which makes a rich and beautiful Covering for the whole Face of the Earth; and if we take into the Account the numerous Tribes of Animals that are in the Waters, on the dry Land, and in the Air; the Instances of Power and Wisdom manifested in these, appear to me more astonishing (if I durst so speak) than what we admired in Matter in general, and in the great Bodies of the Universe.

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P. Especially if we admit into the reckoning, That in every Species of Vegetables and living Creatures, a different and new Artifice is employed: For (as you said) the Art is still heightened with new Additions and Variations, as it were to guide us from the more simple to the more complex Wonders by easy Steps. But this is perfectly as it should be, *Matho:* The Artifice and Variety of Contrivance, must (to our Conception) be greater in Matter, as wrought into Vegetables, and the Bodies of living Creatures, than when rude and undiversified by Workmanship. This is agreeable to what was said, *That the Coarseness of the Stuff lyes concealed under the Variety of Art; and the very Deadness of Matter is disguised with a thousand Beauties of Life and Vegetation.* I know what passes in your Mind on the Consideration of these Things, by what passes in my own. The Mind would fain pursue each Particular separately, till it has admired the Wonders apart: But Admiration itself is soon overpowered, and sinks into undiscerning Amazement. Even this is pleasant. The Time will come——And yet after all, what you observed in another Case is true here: Whatever we consider at the Time must appear to us most wonderful, because our Faculties are every where overcome by an infinite Excess of Art and Power, which therefore we cannot compare.

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LXIV. *M.* The Mind brought to this Impotence of Thought must turn away the View, and change the Object. —— You make the same Distinction, I suppose, of *perfect* and *imperfect* among Animals, as among Vegetables.

P. Every Species of living Creatures is perfect in its own Kind, considered in itself; because exactly fitted to its own Way of Life, and all the Ends of its Existence: But if compared with higher Species, it may be reckoned imperfect, as you yourself observed before of the *Earth-Worm*, compared with some other Reptiles. It is this comparative Imperfection which shews us the Continuation of the Scale, and Series of the Works of Nature above rude Earth. The lower Sort of Vegetables border (as you say) upon the unformed Mold; and in their first Appearance look like *Scurf* or *Rust:* Yet from this low Beginning the several Species of Plants rise, till some of them mimick a Degree of sensitive Life, shrinking up, or contracting their Fibres on the slendereſt Touch. Here the animal Kingdom begins; for some Creatures, as the *Oister* and *Muscle*, are like Plants, rooted to the Place where they were first bred. These seem to have but one, or two Senses at most, the *Taste* and *Touch:* For as they are fixt to the Ground, they have no Occasion for *hearing*, or *seeing*, or *smelling* Objects at a Distance, nor for Difference of Sex.

M. Animal

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M. Animal Life is here indeed very low, and ſeems but one Degree above the Plant, which, you ſay, contracts its Fibres on being touched.

P. As ſenſitive Life is here much confined, ſo ſpontaneous Motion is in the loweſt Degree we can well imagine; the Creature having only the Power to open its Shells for receiving the Food which is waſhed to it by the Waters, and to ſhut them again. Yet this Sort of Life is heightened by various Steps in each ſucceſſive Species, till at length the *ſenſitive Perfection* in ſome Species, as the *Dog*, the *Monkey*, the *Ape*, borders upon human Reaſon. There is ſuch a Diverſity in this, as well as the former Part of the Scale, as we cannot enough admire. No Man of the moſt extenſive Invention could conſiſtently deviſe a Variety, which does not exiſt; nor, without having ſeen them, conceive the Differences that are. Hence the Tranſitions are natural and eaſy. Every middle Species has a Connexion with that immediately above or below it, or ſomething that is common to it with both. Thus a continued Relation, or Affinity of Art and Contrivance, runs through the Whole till it reaches *Man*, who is at the Head of the viſible Part of the Series.

M. Doth not the Scale end where it ceaſes to be viſible?

P. There is no Reaſon to think it does, unleſs we thought the Soul of Man the moſt perfect living Being next to the Deity.

M. That

M. That Thought would be rash, since there is such an infinite Distance between these two. But is there not a Gradation of Perfection in the *living Part*, as well as of Art and Contrivance in the Bodies of Animals. The fifth Conference.

P. It is not so easy to speak on that Subject, *Matho*; and the less easy as it falls in with a Point which has always been much controverted. Thus much we may say with Certainty, that as there is a great Difference between the Talents and Sagacity of one Species and another, so this Difference cannot be ascribed to the different Formation of their Bodies.

M. You almost satisfy me already. *Matter can impart no Power nor Perfection.* The Arts of some Creatures are inimitable, either in hunting for the Prey, or avoiding the Pursuit: And it is but reasonable to allow that the different Contrivance and Formation of the Body is rather fitted to the different Talents and Endowments of the living Part of brute Animals. But what Name will you give to that Principle, by which Brutes perform such surprizing Things, if you do not allow it to be called a Sort of Reason in them?

P. The first Principle which directs *many* Actions of all Animals, and *all* the Actions (I believe) of the lower Animals; and which is the strongest and most wonderful Connexion between the vegetating and animated Parts of the Creation; is much perfecter than human Reason: While the Principle which properly belongs

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longs to the Brute-mind is much inferior to the Reaſon of Man.

M. This is all Riddle: Pray what is that Principle which governs the Actions of the lower Animals, and yet is perfecter than the Reaſon of Man?

P. To tell you it juſt now, would be equal to begging the Queſtion of you: but if from conſidering Appearances you diſcover, and are forced to own it firſt, I ſhall not be obliged to you for allowing a Thing which you cannot deny.

M. I leave the Method to you. But are there no other Connexions, beſides *this*, between the vegetating and animated Parts of the Creation? You ſaid before *that Vegetation itſelf is referable to a higher Purpoſe.*

P. If the Earth had not been productive of Vegetables, it could not have been repleniſhed with Animals. Thus the lower Order of Things is referred to the higher; and in this Senſe the common Expreſſion, *All Fleſh is Graſs*, ſeems to be literally true.

M. And if there had not been Variety of vegetable Productions, there could not have been ſuch a Variety of living Creatures.

P. Abſolutely ſpeaking, the *laſt* of theſe does not depend upon the *firſt*. Infinite Power is not to be circumſcribed. But you obſerved that *infinite Power is conducted by infinite Wiſdom.* Had there been but one Species of each Kind, we ſhould have wanted innumerable Inſtances of the Power and Knowledge

ledge of the Creator. Hence in the settled Course of Nature the Variety of Animals is connected with the Variety of vegetable Productions. Different Sorts of *Plants*, *Herbs*, *Flowers*, are appointed for Food to the several Tribes of Animals. That was to be hurtful to one Species, which is salutary to another. One Creature climbs the highest Rocks for Herbs, another digs in the Earth for Roots, and we scarce know a Plant or Leaf, but what affords Nourishment and a Place of Nativity to some Tribe or other of the lesser Insects, of which there is by far the greatest Variety in Nature. This is the Foundation of innumerable *Relations* and *Connexions* between these two Parts of the Creation; which shews the Work to be *one*, and the Design of the same Power and Wisdom. If we could make the horrid Supposition, that Chance had produced the World, yet what constant *Errors*, *Blunders*, *Misapplications* must there have been! Every Thing must have been monstrous, and such an harmonious System of Things infinitely impossible.

M. I see a Beauty from this Article of Food, which I was not aware of. There must be a pre-contrived Relation and Fitness between the internal Constitution of the Animal, and the Nature of that Herb or Plant, which affords it Nourishment: This opens to us a hidden Scene of Contrivance running through all Nature.

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P. Hence the Design and Usefulness of those *Effluvia*, or *Scents*, constantly emitted by all Sorts of Vegetables: These gratefully affecting the olfactory Nerves, invite the related Tribe to their proper Food; or contrarily.

M. Solicitous Provision of the Deity! Methinks I see every Herb of the Field pouring out a constant Stream of subtile Vapour! Without this Minuteness of Care, the Animals might as well have devoured what was baneful, as what was salutary.

LXV. *P.* As the living Part of the Creation was to rise higher in Variety than the vegetative Part, innumerable other Relations and Congruities appear to us, from the Article of Food and Nourishment, between the Animals among themselves.

M. That I do not apprehend.

P. All the inferior Animals were to be but short-lived; their dead Carcasses were to fall, and lye upon the Earth: Their Superfetation therefore, or the Increase above what is necessary for keeping up the Species, is appointed for a farther Use, namely, to be the Food of other Animals.

M. This I understand from what you said a little before, *That the Almighty Author of Proportion preserves a just Balance amongst his Creatures, by disposing the Superfetation to a farther Purpose.* And surely, to our Apprehension, it had been easier to prevent, than effect such a Superfetation; for what was necessary

to

to keep up the Species, must have been but small, in respect of the present Multiplication. The fifth Conference.

P. From this, innumerable other Relations and Aptitudes, both in the Bodies and living Parts of brute Creatures. Those which are designed to live on animal Food have (as you observed) an inimitable Sagacity in discovering, and the very fittest Disposition of Parts for catching the Prey allotted to them. Nor, on the other Hand, have the weaker Animals fewer Arts and Wiles for eluding the Pursuit. Here Art tallies to Art, and Sagacity to Sagacity. Every Creature knows, without being taught, where it is wanted for Food, and the Animal by which it is thus coveted.

M. This I conceive easily, and could give you an Instance of it from my own Observation. I have watched the Motions of a *Spider* for whole Hours together, and have seen when he durst not attack a larger *Fly*, though entangled in his Nets, 'till he had gone over and over it many times, and at each Time had drawn a new Thread round it; 'till at last it was quite wrapt about with his Chains, and defenseless. But I hate the Spider; he is a bold, cunning, merciless Enemy.

P. It is very right to hate the Image of Cruelty: Yet the *Spider* is just as cruel here, as the *Ox* which eats the Grass of the Field, or the *Caterpillar* which devours the green Herb. Cruelty supposes Injustice, and Injustice a Knowledge of *Right* or *Wrong*, which irrational Creatures have not. Cruelty is the

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Deformity of rational Beings, and neither of the *Lion* nor the *Tiger*.——

M. I'm afraid I am wrong, and ought to change my Way of Thinking a little; for I ſee an unanſwerable Strength of Reaſon in what you ſay.

P. I do not ſpeak thus, *Matho*, with a View to defend a ſanguinary Diſpoſition in Mankind; I ſhould then contradict Reaſon and Humanity; but to aſſiſt you, as far as I am able, to a conſiſtent Way of Thinking, concerning the Works of the Creator. Men firſt make Brutes rational, and then cruel; and then there is an Example of high Authority ſet for the *Tyrant*, the *Ruffian*, and *mercileſs Oppreſſor*.

M. I ſee the Uſe that might be made of this miſtaken Notion.

P. Nor is this the only bad Uſe that is made of it.——A *mere ſenſitive Creature*, whoſe Senſes are gratified, is complete in its Kind, and in the Scale of Being, and has nothing to complain of, though it is not immortal: But we furniſh it with *our Reaſon*, and then the Complaint, which is made in its Name, paſſes with moſt People for reaſonable. Gluttony and Pampering are ſhameful and unmanly Vices, above the Poſſibility of being juſtified: Yet I think it looks as if thoſe who affectedly rail at Mankind, for living in the continual Butchery and Slaughter of the inferior Animals, intended the Invective higher: Or, how will they pretend to accuſe Man, and clear the Creator?

Creator? This is not the Place to consider, what Pain an unreflecting Animal may feel: It is not the ten thousandth Part of what a rational Creature must suffer in like Circumstances; (Anguish and Distress of Mind cut deep every Moment) and it is a Pain that must be multiplied by the Infirmities and Languishing of unprovided old Age. In short, if those nice Folks had no other Meaning but Commiseration to the inferior Animals, they ought never to stir abroad, nor tread upon the Ground, but with the greatest Caution, for fear of taking away the Life of some little harmless Creature. Let them suppose that there were no carnivorous Animal in Nature; and, in Consequence of that, they must suppose that the Species and Individuals, which live on Vegetables, ought to have been incomparably fewer; and therefore that the Species of Plants and Vegetables ought to have been fewer in Proportion. And if the immediate Use of *this Globe* were for the Production of Vegetables and Animals, that ought, likewise, to have been shrunk into less Dimensions. And having thus broke the Scale and Proportion of Nature, let them try how they could mend it again, and give us one of their own Fashion. The fifth Conference.

M. From this I see that what Men ordinarily interpret to be Animosities and Hostilities in Nature, among the Tribes of Animals, are not *Animosities* in the same Sense as those exercised by Men; but the Application of what

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would otherwiſe be a *Nuiſance*, to a farther Purpoſe; and this founded on innumerable, and wonderful Aptitudes and Relations in the Nature and Bodies of Animals, by their Creator.

P. That appears to me the more rational and conſiſtent Way of conceiving this Matter.

M. I agree with you, and think it looks like want of Candor and Fairneſs, to miſconſtrue Appearances, which are capable of having a conſiſtent and rational account given of them. Beſides, it ſeems a Piece of Fool-hardineſs, to meaſure our Knowledge with the Wiſdom of the Creator.

P. Many learned Men have excellently deſcribed the admirable Structure of Body, the Talents and Arts of the ſeveral Species of Animals, for this Effect, who did not ſuppoſe theſe to be Helps to Cruelty, or Inſtruments of Malice and mutual Hatred. In a word, though there were no carnivorous Animal in Nature, might not the ſame, or an equal Objection be raiſed againſt thoſe that feed on Plants? An Army of Inſects is more terrible than the *Wolf*, the *Tiger*, or the *Lion*; the *Shark*, the *Crocodile*, or the *Alligator*. Theſe might be commiſſioned to deſtroy every green Thing on the Face of the Earth.——Or, ought there not to have been any Inſects in Nature? How comes it to paſs then, that there is either *Blight*, or *Mildew*; *Wind*, *Rain*, or *Thunder*, but according to our Preſcription?

M. I see there would be no End of such Objections, 'till Man had overturned all Nature, and made himself independent.—— The fifth Conference.

LXVI. After this, where go we next; or how doth the Scale rise from the *Oister* and *Muscle?*

P. I am not sure if it be allowed, that these are the lowest Sort of living Creatures; and I only offered them as an Instance: Animal Life, like Vegetation, begins very low, in more Species than one or two. Yet, I think, the Inhabitants of the Waters, though exactly fitted to their Way of Life, are less perfect, to our Apprehension, than the Inhabitants of the Air, or dry Land. There are divers Sorts of Shell-fish, which are fixt to one Place; and the first Species that are not thus fixt, as the *Scallop*, the *Periwinkle*, *&c.* have nearly the same simple Composition of Parts, and local Motion, in a low Degree. Others transport themselves from Place to Place, by creeping obliquely on the Ground, or by wriggling or flapping on the Waters, rather than by regular Swimming.

M. I have, indeed, observed these several Sorts of Motion in different Insects, at the Bottom of the Water in small Brooks.

P. It is instructive, *Matho*, and wonderful, to consider the Beginnings of spontaneous Motion in those inferior Creatures. The mighty Author of Nature has imitated Weakness and Infirmity (if the Expression may be par-

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doned,) to make the Tranſitions eaſy, and the Modes of Motion various. This is remarkable, either in Land or Water Animals, according to the Structure of their Bodies: But after we are come to the regular Swimmers, nothing can be more curious than their ſmooth, long Figure, for piercing through that denſe Element. The quick Vibration of the Tail darts forward the Body with a Velocity, like that of an Arrow in the Air.

M. The ſeveral odd Shapes of Fiſhes ſhew us, I think, that there muſt be more Modes of Motion in *Swimming* than *Flying*.

P. And yet, if you obſerve carefully, you will rarely ſee two different Species of *Birds*, or *Fowls*, but what have a different Sort of Motion, even in their Flight.——The ſwifteſt Swimmers begin to ſhew a Tranſition from Swimming to Flying; For one Sort of Fiſh, to avoid the Purſuit of the Dolphin, (as it is ſaid) riſes above the Waters, uſing its large Fins inſtead of Wings. The Connexion between *Swimmers* and *Quadrupeds*, is very plain in ſeveral Species; the *Water-Newt*, the *Lizard*, the *Sea-calf*, the *Alligator*, and the terrible *Crocodile*. The *Otter* and *Beaver*, though amphibious, are perfect Quadrupeds. I cannot pretend to lead you through the Serpent Kind, many of which are likewiſe amphibious, and ſhew another Sort of Gradation from Water to Land Animals. In the *Cameleon*, and *Lizard*, beforementioned, we ſee the Serpent and quadruped Shape blended together.

ther. And many Sorts of Fowls swim on the Waters, as well as fly in the Air. Fishes and Fowls agree in this, that both are oviparous; except the *Whale*, the largest of all Animals, which, they say, brings forth her young alive: Whereas the more perfect Land Animals are viviparous, and bring forth their young completely formed. The fifth Conference.

M. Might there not be as large Animals at Land, as in the Sea?

P. The Weight of the *Whale* is supported by the Water, a soft and yielding Element, and therefore by near the Surface of its whole Body: Fishes being generally of almost the same specifick Weight as Water. It is otherwise with Land Animals; the *Elephant* is supported on four Feet, a much less Extent of Surface in Proportion to the Weight.

M. I should think the whole Weight of the Fish were supported by the under-half of its Body.

P. If the whole Weight were supported by half the Surface, when the half of the Body were under Water, the Fish could sink no farther.

M. It must be so; when the Fish is almost quite covered, the Water presses against every Part of its Body.——I could give you an Instance of the Connexion between different Species of Animals, if I were not afraid it might be trifling.

P. It

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P. It is not fair, *Matho*, to be thus on the Reserve; as if we were watching for each other's Mistakes.

M. I have often admired the Species of *Mice* and *Birds*, united, as it were, in the *Bat*, which wants only so much of a perfect Mouse, as to shew the Transition to the Bird Kind.

P. This Instance is far from trifling. The Bat is viviparous, and suckles its young, as other Mice do. They have no Feathers, but are, like Mice, covered with Hair, and fly by the help of a large Pair of Membrane-Wings, the Contrivance of which is very singular, being extended on each Side, between the fore and hind Legs.

M. And behind likewise; so that these Wings are extended round the whole Body, except the Head of the Animal: And surely this is a strange Art in contriving Flight.

P. There is a Species of *Squirrels* too, they say, which flies; and one Sort of Lizards certainly does: And many Kinds of Insects, which at first creep about under various Figures, at length take Wing, and mount in the Air.

M. You have not yet told me of any Creatures that change from one Species to another; pray explain that Particular.

P. I shall better satisfy your Curiosity, and give you a stronger Idea of some of those wonderful Transformations, by shewing you the Figures of several beautiful *Butterflies*, and of the

the *Caterpillars*, under the Form of which they at first creep about upon the Leaves of Plants, drawn from the Life, by the Hand of a Lady *. The fifth Conference.

LXVII. *M.* Here is such a large and beautiful Butterfly, as indeed I never saw before.

P. It is no Wonder; these are bred in warmer Climates. Look; here is the same Creature, (or the Parent of it rather) feeding on that Plant, in a different Shape.

M. Bless me! This is a monstrous, loathsom, prickly Worm! I scarce think it possible that such a glorious Animal should rise from that hideous Thing.

P. Ah! *Matho!* I thought you had other Notions of Possibility, when we were speaking of the Works of the Almighty.

M. Pardon me, it was my Surprize. I have seen Creatures somewhat resembling this before, creeping about on the Ground, or on the Blades of Grass; but not near so large and ugly.

P. You will see Variety of them by turning over.——

M. Here are many Sorts indeed, as beautiful in the one State, as disagreeable in the other. ——Here are monstrous Spiders too.

P. The Description of these on the opposite Page will surprize you.—

M. What terrible Animal is this?

* *Madam* Maria Sibilla Merian, *of* Amsterdam.

P. That

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P. That is a *Surinam* Crocodile, *Matho:* But you may look over the Book at your Leisure another Time.

M. You believe all these Things then.

P. The Author of that Book was none of your *romancing Travellers:* She sailed to the opposite Part of the Globe, to collect these Curiosities of Nature, many of which she brought home with her. Besides, the Cabinets of the *Curious* are full of such Creatures preserved. And though there are not, perhaps, such Varieties of Species here, yet these Transformations are as frequent, or rather constant with us, as in *America.*

M. Pray explain to me the several Steps of this wonderful *Metamorphosis.*

P. You will find an Account of this to better Purpose in those Authors, who have professedly treated on this Subject: But to give you some Sort of Satisfaction at present, You must know, that the Butterfly, or Parent-insect, lays her Eggs in some convenient Place, where they may be safe from Accident, and her Off-spring find suitable Food when hatched. The Animal first produced is a small Maggot, or Worm, which feeds on the Leaves of the same Plant where it was hatched. The Nettle is a great Regale for one Species of them. This Maggot soon grows, by its luxuriant Food, to the Bigness of a Caterpillar, or of those hairy Worms you have seen creeping about on the Ground. After they have completed a certain Period in this Form, they retire to some Shelter,

Shelter, and build themselves a *Repository* or *Tomb*, as if satiated with this Sort of Existence. Here the Animal is to pass into a State of Insensibility, or rather dies: For the organized Body loses its Form, and becomes again a Sort of Chaos, or is reduced into a Mass of Confusion. But this proves the *Embryo* of a different Creature; for from it comes out a shapeless Thing, called a *Chrysallis*, or *Aurelia*: And from that deformed Production rises a beautiful Butterfly, curiously formed, adorned with painted Wings, and fit for Flight in the Air.

M. And in what Time are all these Changes performed?

P. In a few Months of the Summer.

M. Pray can you shew me all the *three States* of the same Animal, in any of these Figures!

P. All three are represented on almost every Plate. Turn to Plate 38. Here is the Caterpillar of an enormous Size: Upon that Stalk below, is the *lumpish Aurelia*, into which it is transformed: And this is the Butterfly or *Phalæna*, which rises from the *Aurelia*. It remained in the *Aurelia*, or *insensible State*, from the 23d of *June* to the 20th of *August*.

M. What are these?

P. That is the *Proboscis* of the Animal, three or four Inches long, divided into two. It unites both Parts, and thereby forms a *Tube* or *Pipe*, wherewith it sucks the Honey from the Bottom of the Flowers.

M. What

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M. What are your Thoughts concerning this Metamorphosis?

P. It appears to me to be a successive Evolution of Bodies, such as perhaps the *Greeks* would have called a *Metasomatôsis*: But whether, as there are three different Bodies, one included in another, there be three different living Creatures, or only two, or but one, I cannot determine.

M. This is the most wonderful Particular I have yet heard of.

P. It is indeed a Miracle made constant, or appointed to be a settled Course of Nature, (as every Process of Generation is, if rightly considered:) For the Species of these Creatures, which pass through Changes analogous to this, are very numerous. The *Silk-Worm* is one of them; and the Place she builds for her Transformation is all of that soft and fine Material. The common white Butterfly comes, by a like Process, from the green Caterpillar you have seen feeding on Cabbage-leaves. And all those Sorts of *Phalænæ*, or *Moths*, which fly about in the Evening, or by Candle-light, are thus produced by a double or triple Generation.

M. I am glad there are so many Species of them; I shall the more easily observe those surprizing Changes of Figure in one or other of these Sorts.

P. See here on this Plate, drawn by the ingenious Mr. *Bradley*, Eggs of the Silk-Worm:—That is the *Caterpillar* or *Nympha*, which

which is hatched from these Eggs:—This is the *Cone*, or *Bag of Silk*, which the Caterpillar spins for her own Monument:—This lumpish Thing is the *Chrysalis*, which is excluded from the Ruins of the Caterpillar's Body.—And this is the Butterfly which proceeds from that Chrysalis, and again lays the Eggs, to renew the same Circle of Generation. The fifth Conference.

M. One cannot enough admire this complex Process.

P. Below you see the Caterpillar that feeds upon the Nettle, with the Chrysalis and Butterfly arising from it.

M. It is this Sort of Caterpillars, but somewhat blacker and larger, I have seen creeping about on the Ground. But what mean these Horns of the Butterfly?

P. These are called its *Antennæ* or *Feelers*, of which there is a great Variety, according to the several Species of those Animals. They have likewise *Tubes* or *Suckers*, as you saw above, for thrusting down into the Sockets of Flowers, which at other Times the Insect coils up very artificially under its Mouth, so that they do not appear.

LXVIII. *M.* I have observed this Sort of Butterfly to hang or stick, as if it were dead, in some *By-Corner* of a Room, during the whole Winter; and to begin to fly about again when the Season became warmer.

P. There are many Creatures, *Matho*, which thus pass the Winter in a State of Numbness

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or Sleep, and revive again in the Spring. Had the Place been warm enough, you would have ſeen the Butterfly flutter about the Glaſs of the Window in the Day-time, all Winter.

M. I remember, indeed, to have ſeen, after a long and ſevere Froſt, the little Flies begin to move and jump about, even upon the Snow itſelf, before it was quite diſſolved. Pray how can theſe little Animals endure ſuch intenſe Cold, for ſo long a Time, without periſhing? They have neither Coverings of Hair, nor Wool; nor Shelter to fence them from the piercing Winds, nipping Froſts, or Rain. Larger Animals would be ſtarved to Death in one ſingle Night of ſuch Lodging.

P. All we can do here is to admire, without being able to underſtand, how theſe Creatures are thus preſerved.

M. How can they live without Food all the Time?

P. Naturaliſts obſerve, that while in ſuch a State they ſuffer no Waſte or Decay of Parts; and therefore require no Food.

M. Should you or I ſuffer no Decay of Parts, if we ſlept conſtantly for three or four Months together?

P. The Caſe is different: We ſhould ſtill breathe, and perſpire, (as they call it) which would occaſion a conſtant Waſte of our Bodies.

M. Do not theſe Animals live, while in a dormant State?

P. I confeſs, *Matho*, I do not underſtand theſe Things, and therefore cannot anſwer your Queſtions.——

M. You ſaid the *Inſects* returned only with the Verdure and Herbage of the Earth, which was to afford them Food.

P. None of thoſe winged Inſects which ſurvive the Winter, feed on Plants or Leaves: Theſe are their Food only in their *Nympha*, or *vermicular State*, the Summer before. They change their Diet with their Shape; nor have the winged Creatures any Apparatus, I believe, for Maſtication of Vegetables.

M. Are there no largar Animals than *Inſects*, that paſs the Winter in a State of Numbneſs and Sleep?

P. The *Bats* you mentioned are another Species of thoſe *Sleepers*.

M. Theſe I might have thought on: I have known their Retreat in a Hole of a Wall, where great Numbers of them lay the whole Winter, without ſtirring.

P. The *Swallows* likewiſe retire in *October*, and paſs the Winter in a motionleſs, and ſeemingly lifeleſs State, under the hollow Banks of Rivers; ſo that not one of them is to be ſeen in all the Country, after a certain Day.

M. Might not one try to keep them in Cages all the Winter?

P. It is a Creature that cannot be tamed. Though the *Lion* and the *Elephant* may be made familiar with Mankind; yet ſuch ſmall

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Creatures as the *Mouſe* and the *Swallow* are quite untractable; as *Pliny* informs us.

M. I am willing to believe it; for the leſs Creatures are, they ſeem the more imperfect, and muſt therefore be the more intractable. No Art, I believe, could tame a *Beetle* or a *Spider*.

P. Some Animals are of a ſavage Nature: But the chief Reaſon ſeems to be, that we do not know their Diet. The *Swallow* lives on Inſects, and is the only Creature that feeds flying. On this account, Providence hath kindly ordered its Retreat during the Winter: And on the ſame account, all Sorts of *Spiders* paſs that Seaſon in a dormant State: The *Serpent-race* alſo, which feed on *Frogs*, *Toads*, and ſuch like Animals, ſuffer an Intermiſſion of Senſe all that Time.——

Qualis ubi in lucem coluber, mala gramina paſtus,
Frigida ſub terra tumidum quem bruma tegebat.

M. You deal much in the Poets: But this does not ſatisfy me how the Bodies of theſe Animals, eſpecially the *Swallows*, could lye ſo long in ſuch Circumſtances, without being diſſolved, or corrupted.

P. I have as little to ſay to this Inſtance, as to that of the *Inſects*. If the Blood of the Creature circulates all the while, that will prevent Corruption or Diſſolution.

M. The Difficulty ſtill remains. Why does not lying ſo long in ſuch wet and terrible Circumſtances,

cumstances, directly stop the Circulation, and kill the Creature?

P. As these several Species of Animals, *Matko*, are singular Instances of the Creator's Care, and of the various Methods of his Providence; so his Power is manifested in them, above the common Course of Nature: And it shews us, that when he pleases, the Continuation of Life does not depend on Food. It is certainly Matter of Admiration, that an Animal should live only two or three Months of twelve, and pass all the rest of the Year in a State of Insensibility: And yet, by all the accounts I have ever heard, this is true of the *Cuckow*; which, having early finished the Business for which it appears, retires in the Month of *June*, and is not seen again (at least with us) 'till the *April* following. Nor is it reckoned among those Birds which change their Climate.

M. This is, indeed, a notable Instance of Variety.—But with Respect to the Life of Animals; pray tell me how it happens, that if a Part be cut off from some Creatures, that Part seems to live for a considerable Time by itself, or at least moves? I have seen the Tail of an *Eel*, when separated by a Stroke from the Body, move and twist itself for a great while.

P. I am as ignorant of this as you are. *Anatomists* have observed, that some *Insects* have several Lungs, and therewith several Hearts. This might account for the Boys cruel Diversion, of seeing a *Fly* whirl round,

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after they have taken off its Head: But it is not applicable to *Serpents*, *Eels*, and ſeveral Sorts of *Fiſhes*. The very *Leg* of an Inſect will move for a ſmall Space, when torn from the Body, where there can be neither Heart nor Lungs.—With reſpect to all theſe Things, I can only ſay again, that our very Ignorance is not without Satisfaction, when we conſider that it is neceſſary concerning Objects, where infinite Knowledge and Power have been exerciſed.

M. It muſt be ſo indeed. But

LXIX. As ſome Birds retire to paſs the cold Seaſon in a State of Inſenſibility, you ſeem to ſay that others remove to diſtant Countries then.

P. It is certain many Sorts of Birds ſhift their Climate according to the Seaſon of the Year. The *Woodcock* comes to us in *October*, and the *Quails* in *April*; and after ſome Stay both Sorts retire again. Theſe are called *Birds of Paſſage*. One Sort of Geeſe comes yearly to breed on ſome particular Rocks only on our Coaſt, and are ſeen no more the whole Year round. The *Stork* and the *Crane* have been memorable in all Ages, for their annual Peregrinations, though they do not viſit us. Theſe Birds of Paſſage are ſeen after their Return, and are obſerved to aſſemble in great Flocks in order to go away; but no Body ever ſaw them coming or going: Whence it has been ſuppoſed that they remove and return only

ly in the Night Time. But what seems wonderful in this Case is, that they steer their Course, as well over Sea, as dry Land. When the Woodcocks come to our Island, they are under a Necessity of crossing the Sea. Quails have been often seen in their Passage at great Distances from Land. There are other Sorts of Land-Fowl also, which Mariners are surprised to see flying above them, a great Way from any Coast. Nor is it less certain that some Species of Fishes pass and repass between distant Parts of the Ocean annually at stated Seasons. The *Salmon* in our Rivers swim up as far as the Water can carry them, for the sake of repositing their Spawn in such a Depth, where the Influence of the Sun may reach it; which having performed with surprizing Exactness, they return without farther Concern, leaving the future Fry to be instructed in the Arts of Life, in the watry Element, by another Hand.

M. The Meaning of that Expression I do not conceive; but though every Particular you have told me be wonderful, yet it is most surprizing that Birds bred at Land should fly quite out of Sight of it, and venture themselves above the Ocean, where they can have neither Food nor Rest! How know they on what Point of the Compass to fly; or that there is at all any Land beyond such a Tract of Ocean? Did they ever consult the Map for the Situation of Countries? Or what do they when Night overtakes them?

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P. Do you think, *Matho*, if you were put between a Pair of Wings, that you could guide yourſelf through the Air, and in the dark too, to a diſtant Country you had never ſeen before?

M. The greateſt Philoſopher could not do it: It is a Thing above the Reach of human Knowledge.

P. You own then they are guided by ſome more perfect Principle than human Reaſon?

M. I remember what you ſaid, but will own nothing, till you tell me the Principle itſelf.

P. Have you ever conſidered a *Honey-Comb*, or a *Spider*'s *Web*?

M. Often, and with Admiration.

P. Who teaches theſe little ſhapeleſs *Inſects* to work ſo artfully with ſuch Tools, and in ſuch Materials?

M. I cannot tell; but it is ſtrange that the *Spider* ſhould ſpin a Subſtance, which is liquid in its own Body, into ſo fine, and withal ſo ſtrong a Wire.

P. The Wire which the *Silk-Worm* draws out of the Juice of her Body is no leſs remarkable both for Strength and Fineneſs. A hundred Yards of it do not weigh a Grain.——

M. But this is from the Purpoſe of my Queſtion.

P. Not ſo far as you imagine. Tell me if a *young Lady* were transformed into a *Silk-Worm*, or a *Spider*, as the Poets ſay *Arachne* was; do you think that her being ſhrunk up into

into that diminutive Figure, would teach her either of these notable Arts?

M. That would be to suppose that the *mere Figure* taught these Insects their Dexterity. Their Figure can teach them nothing, though it must be adapted to their Art, as was observed before. A *Loom* could not teach a Man the Art of Weaving, nor any other *Instrument* the Art in which it is employed: But one, who understood or had invented the Art of Weaving, might contrive a *Loom* to put the Invention in Practice.

P. You argue unexceptionably well, *Matho.*

LXX. We admire the Wire drawn by a Worm or Spider: What do you think of the *Hair* and *Wool* of Animals?

M. I can see no Similitude between these and the former.

P. The *Hair* and *Wool* of Animals are formed out of a liquid Substance; they are fine and strong too.

M. But they grow, instead of being drawn, or spun.

P. Does *growing* then appear so slight a Thing? These seem so much the more wonderful, as there is no living Creature to assist or produce the Effect; there is nothing here but unactive Matter.

M. I am afraid I shall be obliged to come over to your Side.

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P. Hair and *Wool* are more than Wires: The *Curious* have obſerved that the ſlendereſt Hair is a hollow Tube, with a Pith, or internal Subſtance in it.——Obſerve this Figure: Here is the ſingle Hair of a Mouſe, as obſerved through a Microſcope by the excellent Mr. *Derham*.

M. Surprizing! Is this Variety of Work within the Compaſs of a ſmall Hair? How amazing is this Minuteneſs of Art!

P. The Hairs of larger Animals are each a Bundle, or Congeries, of ſuch Pipes or Tubes, which in ſome Caſes can be ſeparated: So that Finery, Deſign, and a Complication of Contrivance reigns every where, in the very excrementitious Parts of the Bodies of Animals.

M. Well, I own that the ſingle Hair of a Mouſe is by much a more fine and artificial Thing than the Spider's or Silk-worm's Thread. I did not reflect on the Myſtery of Vegetation; the particular Direction of every Atom! But even theſe Threads or Wires are wonderful, if we conſider them as the Manufacture of a poor little Inſect.

P. Yes, if we might conſider them in that View: But you have allowed already, if one of the human Species (ſome great Philoſopher, for Inſtance) were contracted into this diminutive unpromiſing Shape of a Caterpillar or Spider; that the being transformed into ſuch a Figure, could not teach him that Art.

M. It

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M. It could not, if he did not understand the Method and Secrets of that Art at present, with the Help of all his Reason. If mere Shape or Figure can teach a Creature nothing, Change of Shape or Figure could not teach the Philosopher more.

P. Do you think that the Caterpillar knows what it is doing, and to what Purpose or End it works, while it manufactures the Silk?

M. Why should it not?

P. Does it know that this Cone of Silk is to be a *Repository*, where the Remains of its Carcass are to be ripened into a *shapeless Grub*, out of which a nimble-winged Creature is to rise?

M. Pardon me; it cannot know this wonderful Process of Generation, nor what is to spring from the Decays of its own Body. This exceeds the Knowledge of the most perfect Animal.

P. It cannot then have any Notion of what it is doing, while it is building its own Monument?

M. It works thus, I suppose, without Knowledge, for the satisfying of some Appetite.

P. You owned before, at our last Meeting, that Power, not directed by Knowledge, is but *blind Chance*, or *Temerity*, which can produce no consistent or regular Effect. But here in this Operation, the Insect works on a long, pre-contrived, and really mysterious Design, without knowing what it does; and yet it

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it does all in the moſt regular Manner. For here you are to remember, that every Individual of the Species works exactly in the ſame regular Form, and that for the firſt Time: A Creature can die but once.

M. I know not what to ſay then, or how the Animal is directed. I am ſatisfied it cannot know the *Metamorphoſes* that are to ſucceed: And how it ſhould act ſo conſiſtently to this End, and not know of it, I cannot find out.

P. Does the *Spider*, think you, know before hand the Nature of the Liquor in her Body; and that it will become a tenacious Wire in the open Air, though ſpun ſo fine?

M. I am at a loſs what to anſwer to theſe Queſtions. I am ſure we could not know the Nature of this Liquor, but from the Effect already performed: And I do not think the *Inſect* knows the Nature of the Liquor at all, but falls directly to ſpinning, I cannot tell from what Principle.—

P. The diligent Enquirers into Nature have obſerved, that many Sorts of flying Inſects have a *Piercer* or *Terebra*, with which they wound the Buds or Leaves of Trees, Plants, Fruits; and inſert in the Wound their Eggs, with a Liquor or Kind of Venom, which perverts the regular Vegetation of the Plant, producing an Excreſcence, where the Egg is hatched, and the Maggot fed; or where perhaps the Animal, according to its Kind, is preſerved the whole enſuing Winter.

M. This

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M. This is agreeable to what you told me before, of Plants serving for Food, and a Place of Nativity, to the first Period of *Insect-Existence.*

P. Now can these little Creatures know, that the Liquor they shed is of such a hurtful Quality to the Plant, as to distemper, or raise a Swelling, or *Button* upon it, which may afford Lodging to their Young when hatched? Or that the Matter of this Excrescence will be proper Food for them, till the Season returns, and the Verdure of the Earth is renewed? For, as was said before, the *Mother-Insect* never tasted of this Food herself, but pursues quite a different Sort of Diet.

M. That would be to allow them a readier Insight into the Nature of Vegetation, and a more extensive Knowledge into the Congruity between one Thing and another, than Man has with all his Experience, or could have, unless he were thus taught by what these little Animals practise. And I think it is not to be imagined that a Creature, which lives but for one Season, should know any thing of the Variety or Return of Seasons.

P. You are in the right; these Creatures are produced themselves, a few Weeks only of the Summer before they do all this. And there is one Species of these little Insects, which lives only but a few Hours after it becomes a winged Animal; and yet it performs all the Offices relating to its Posterity, as if it had acquired the Experience of many Years.

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M. One cannot enough admire thoſe Miracles of Nature.

P. Let us again take a View of the little *Fry* in the Waters, which, immediately on being excluded the Spawn, are left to ſhift for themſelves in the midſt of a rolling Element, ſurrounded with innumerable Enemies; and yet, without Tutor or Guide, they inſtantly become perfect Maſters of all the Arts of Life, as I obſerved—

M. Pray, without giving me more Examples, or aſking me more Queſtions, ſhew me how theſe little Inſects act thus regularly, without knowing what they do? Or by what *Principle* they are thus guided to purſue ſuch diſtant Proſpects? For I grant you now as much as you pleaſe, that this Principle is inconceivably ſuperior to the Reaſon of Mankind.

P. You know I am not raſh in anſwering ſuch Queſtions.

M. Well! Thus it is to be nurſed and tutored in what one does not know by one's ſelf.

P. More Examples (as you ſay) are needleſs; for it is by thoſe untaught Arts, and unknown to theſe weak Creatures themſelves, that all the inferior Species, without any Exception, are continued as ſecurely, as the Race of ſtronger Animals, or as Man himſelf is.

LXXI. *M.* I am ready to believe it; such Weakness must be conducted by some wonderful Art: But in the Interim, till I can know more of this Affair, pray inform me if all Sorts of Insects go through these Changes, from a first, to a second and third State of Existence?

P. All do not; there are many *Reptile-Insects* which never take Wing; but all winged Insects (so far as I know) pass through one or more Changes; if perhaps we except the *Ant*, for some of them likewise get Wings. The different Transformations of the *Gnat* are not less wonderful than those of the Moths and Butterflies; and in one Respect more wonderful, as their first Stage of Existence is in the Waters. So that this Insect alone shews us the Transition from Creatures that live in the Waters, to those that subsist on dry Ground; and again, from those that swim or creep, to those that fly in the Air. And indeed the Species of those winged Insects, which pass their vermicular State in the Waters, are very numerous. The *Ephemeron*, which, as was mentioned just now, lives but a few Hours in its last State, is one of them. Some of these form to themselves, by the Help of a glewy Substance, which descends to the Bottom of the Water with the Eggs out of which they are hatched, little rough *Cases* or *Tubes* of Sand, small Gravel, or the like; which they draw after

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after them when they ſearch for Food, and into which they retire in Time of Danger.

M. I now remember; it is long ſince I have obſerved theſe artificial Caſes, in Springs and ſmall Brooks; and was ſurpriſed to ſee a Compoſition of Sand, ſmall Stones, and other Materials, as I imagined, move like a living Creature.

P. The *Scarab*, or *Beetle-kind*, of which there are ſeveral Species, undergo Transformations not unlike thoſe taken notice of before; as doth the beautiful Inſect called the *Lady-cow*, paſſing through a *Nympha*, *Aurelia*, and *mature* State; and it has, like the Beetle, what they call *Elytra*, or *Caſe-wings*.

M. From what you ſay then, I underſtand theſe *Elytra*, or *Caſe-wings*; for we have often been diverted with ſeeing the Beetle prepare for Flight; and the Sight is really entertaining. He firſt raiſes one of his black Scales, as if he were opening a Door in his Side, and extends a folded Wing, which he expands at Leiſure. Then he opens the Caſe on his other Side, and having put the other Wing in Order, takes Flight. He makes an odd Sort of a Figure while on Wing, with his two Scales ſtanding erect, as if he carried ſomething on his Back: Nor is it leſs amuſing to ſee him alight; for as he does not fly far, we have followed him. He takes ſome Time to fold up his Wings again, which he does by Degrees, firſt on the one Side, and then on the other;

other; and having brought them within their *Cases*, he claps down the Lids on them. The fifth Conference.

P. It is a singular Creature indeed, as if it were a Composition of a Tortoise and a winged Fowl.

M. We have teased him to make him fly; but being harassed, he rather trusts to his *Coat of Mail*, than to his unwieldy Flight.

P. It is still more wonderful, that such a Creature as the *Spider* should fly, without the Help of any Wings at all.

M. I can have no Notion of their flying; but I have observed a Spider to jump, or dart itself to a considerable Distance, from one Part of the Wall to another, and sometimes perpendicularly upward.

P. Though I never saw them fly, I am satisfied of the Fact, as Persons of the greatest Veracity have given the Accounts of it, and vouched it from their own Observation.

M. Then, I think, I understand how they extend their Webs between the Tops of Bushes, and very often a-cross small Rivulets: They must either fly, or dart themselves over with their Threads.

P. It must be in some such Manner, for they are not *Swimmers*; and a great Part of their Game is over small Brooks.

M. But pray what are we to think of those innumerable Threads, which we often see stretched upon the Tops of the Grass, all parallel-wise, so that whole Fields are sometimes covered with them, especially after the Harvest-

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Harveſt-Months? If you look at the Ground between you and the Sun, when riſing or ſetting, you will ſee the Threads ſtretched along, ſhining like Virginal-ſtrings.

P. Theſe, they ſay, are the Work of *Field-Spiders*, or *Wanderers*, as they are called; but whether ſuch Spiders leave their Threads looſe at one End, to be diſpoſed in a parallel Direction by the Wind; or if they leave them quite looſe and floating in the Air, I can give you no Information.——

M. I have a Suſpicion, that other Animals undergo conſiderable Changes of Figure, between their firſt and laſt State, as well as *Inſects*.

P. All Animals whatever, I believe, are of a different Form, when yet imperfect, from what they are afterwards: But on what Ground do you entertain this Suſpicion?

M. I have ſeen in Ditches, Ponds, and ſtanding Waters, *Frogs*, under three or four different Shapes. I have caught them in my Hands little *Tad-Poles*, with ſmooth round Heads, and finny Tails, by the quick Vibration of which they could ſwim pretty nimbly, conſidering the Club-figure of their Heads. I have ſeen them with their Head and Belly larger, and two Feet ſprouted out behind; but they did not then ſwim ſo cleverly. By viſiting them every Day, I have caught them with two Fore-feet, not fully branched from the Body, and the Tail ſtill pretty long: And I have ſeen them with the Tail not quite fallen

fallen away, after they have left the Water, and been leaping about on the Grass. In a little Time after, they had no Vestige of their Tad-pole Shape. Here seems to be an Evolution of Members, at least: For the Animal in its first State appeared as different from itself in the last, as a *Fish* is from a *Quadruped*.

P. It is not difficult to observe thus far, *Matho*; but the Animal had undergone considerable Changes from its seminal State, before you took notice of it. And if the Observation were as easy to be made on other Creatures, probably there is full as great a Difference between their *first imperfect* and *last specifick Figure*. All the larger Creatures seem at first to be *Swimmers*, as they are surrounded with a Liquor.

M. Perhaps the first Thing discoverable here, is an Animal in Miniature, as it was in Vegetables, where the future Plant is so discovered.

P. It is so indeed; the first Thing discernible, is a small, spontaneous, moving Creature, or Animalcule; but (to use your Expression) as far different from the future Animal, as a Fish is from a Quadruped. As to the Genesis, or first Formation of this *Animalcule*, we are entirely Strangers to it. Nature (to speak in the common Way) has carried the first Beginnings of animal, as well as vegetable Life, quite out of the Reach of our Faculties.

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M. Some Things occur from what you ſay, which ſurprize me. If the *Elephant*, the *Horſe*, the *Stag*, and the *Bull*, were firſt in the Form of the *Swimming Fry*, they muſt have undergone great Changes indeed! When I compare this with what I obſerved before, concerning the Formation of Inſects, by a double or triple Proceſs, it is exceedingly more wonderful than what we admired before, in the Propagation of Plants by Seeds. And I differ ſtill more from *thoſe* who aſcribe the regular Continuation of the Species, either from Plants or Animals, to certain little, pre-exiſting, or pre-contrived ſeminal Atoms. Every Thing in theſe *ſucceſſive Evolutions* requires the immediate Operation of the Creator's Hand. If thoſe Things were left to the Care of dead Atoms, and if any Thing at all could be produced, what ſhould hinder *one* Grain from riſing where *another* was ſown? or the *Fox* or *Serpent* to be formed inſtead of the *Lamb* or the *Dove?*——O! the amazing Univerſality of thoſe Miracles, which are conſtantly wrought through the whole Creation, that we may have a regular Courſe of Nature!——How ſhall I deſcribe the Burthen of Thought which I feel in my Mind, when I would purſue the Power of the *Creator*, every where at once forming the living Part of the Creation!——

P. I ſhould almoſt envy your Pleaſure, *Matho*, if I did not participate of it: But no

Words

Words can express such a Scene of Power, where Admiration itself must fail.——

M. Shall we conclude then from what we have observed, that Fishes suffer the least Change of Shape, before they come to their adult Size; as their State of Perfection and Imperfection are not so far asunder as in other Animals? That all Bodies are formed out of Matter in a liquid Form? And that Fishes are the eldest Children of the Creation?

P. There is a Degree of Probability in all this: But it is rather Time to conclude our present Conference. If we grow more minute, we shall grow more trifling; because we cannot talk on such Subjects, beyond a certain Point, with Intelligence.

M. I find I cannot recal all the Questions I had a mind to ask at this Time; only let me observe, that

LXXII. One Thing you said a little before, concerning Insects piercing the Leaves and Gems of Plants, clears up a Particular I did not before understand, and relieves me from a Prejudice. I have often been surprised at those little Berries upon the Back of the Oak-Leaves, some red, and some a greenish white, but did not understand their Original: Now I suppose they are the Excrescencies raised by some Insect wounding the Plant, and leaving its Eggs there.

P. These are raised by a black Sort of Fly, of the Shape of a large *Ant*, which is one of

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what they call the *Ichneumon* Kind. If you had visited those Berries through the succeeding Winter (for they stick on the Leaves during that whole Season) you would have seen the several Advances of the Formation of the Insect. It becomes a clear whitish Maggot, not unpleasant to look at; which about the Month of *March* eats its Way out of Confinement: And then you may perceive those Berries, each with a Hole exactly round in it, through which the Insect creeps out. You will frequently see also such Swellings on the Back of the Willow Leaf, but broader.

M. I know now likewise what to think of those Worms I have found in *Pease*, *Rasp-Berries*, and even *Nuts*, which before I was at a loss how to account for. I have often heard that Maggots breed spontaneously in Flesh, or any Thing that begins to putrify; and was not sure but these might have been bred the same Way.

P. It is now discovered, *Matho*, by the most *accurate Enquirers*, that there is no such Thing in Nature as this spontaneous or equivocal Generation you mention. Every Insect, how minute and contemptible soever it may appear to us, is produced, by a regular Process, from others of the same Species. If no Plant, the most imperfect, rises unless from a Seed of the same Kind, it is not to be imagined that a regular Course of Nature should not be as constantly observed in the Propagation of Animals. It is true, after we have discovered the

Nature of Matter to be what it is, we must be certain that no Plant, or Animal, could be produced without the immediate Power of the Creator, whether raised from a Seed or not: But lest we should be stumbled by our own Inattention, the Deity hath taken Care, (if I may so say) that the first *Stamina* of every Production should have passed through infinite Art, before it come within our Ken. Hence we cannot but revere the *Divine Wisdom* and *Goodness*, in putting it thus out of our Power to doubt.——Flesh of any Sort, if it be carefully covered up, so that no Insect can get at it, to lay its Eggs there, will never verminate or breed living Creatures, as hath often been tried. There are indeed some dubious Appearances, that seem at first to favour irregular Generation: But when Circumstances are closely considered, the Difficulty disappears.

M. What Appearances are there?

P. As the *lesser Insects* are extremely productive of their Kind, they are constantly depositing their Eggs in all Places where they may be hatched and fed; on *Herbs*, *Fish*, *Flesh*, *Liquors*, and the *Bodies* of other Animals. This occasions Abundance of equivocal Appearances. Hence it comes to pass that some Sorts of Insects are hatched on the Bodies of living Animals as Vermin; the Eggs being deposited on these by the *Parent-Insect*. There are few larger Animals that are not thus infested with a particular Sort of *Insect-Vermin*,

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eſpecially when lean, and in bad Caſe, juſt as it was in Plants. And the Bodies of dead Animals afford a convenient *Nidus* for the Eggs of others. The Caterpillar laid up to be turned into the *Chryſalis* of its Kind, having been punctured by other Inſects, has bred a Neſt of Maggots of a different Species, inſtead of advancing in the regular Proceſs: And I have ſeen a living Inſect, on being taken out of the Water, void another of a Tribe not at all related to it.

M. Theſe are equivocal Appearances indeed, enough to ſtumble one, who is not aware of this Manner of Conveyance.

P. As Water itſelf, Graſs, Herbs, Fruits, and even Liquors, abound with the Eggs or Spawn of Creatures of different Forms; it is no Wonder that Worms of various Kinds ſhould be bred in the Inteſtines and other Parts of larger Animals; having been conveyed thither with their Food and Drink.

M. It is not: The Wonder rather is, I think, that other larger Animals are not eaten up with an internal Vermin, thus conveyed into their Bodies. This makes me reflect on what you ſaid before, *That an Army of Inſects might be more terrible than the Lion or the Tyger*, and that more Ways than one. I now plainly ſee, that the leaſt and weakeſt Creatures in Nature might prove too ſtrong for the greateſt, and devour them ſafely, having thus got into their Bowels.

P. Nor

P. Nor is it at all wonderful, that Creatures hatched in such unnatural Circumstances should degenerate and vary from their specifick Size and Figure. Nature (to speak still in the common Phrase) designs every Thing regular in its Kind: But Accidents may prevent Nature; and therefore *Accidents only occasion what is preternatural and monstrous.*

M. Make this a little plainer.

P. If the Young of any Species whatever should be brought forth, with any Part of the Body double or superfluous, that is a Token that Nature designed two; but some external Cause or Violence disturbed the natural Formation, and blended both into one. And it is equally conceivable, that by such violent Disturbance a Limb may be displaced or wanting: For the *Fœtus* being then tender and ductile, the Vegetation or Growth proceeds in different Manners.

M. I understand: It is as easy to conceive this, as that *Children* should grow deformed, or irregularly shaped, by a Fall, or some Accident, even after they are born. A Tree, or the Fruit of it, might be made to grow in various Shapes, I suppose; if it were gently trained from the natural Bent, when flexible and tender.

P. You are in the right. Now if a Child should be born without Legs, or without Arms, (Instances of which have been) taking the external Violence or Accident into the reckoning; it is just as natural, as that a Man should

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have a *Cicatrice* upon his Body after a Wound or Sore; or as that he ſhould have but one Leg after the other hath been ſhot away.

M. What you ſay of having the Parts of the Body double, brings to my Mind the famous Story of the *Twins* in the Reign of *James* the Fourth of *Scotland*, which thus appears not impoſſible at leaſt.

P. Theſe Brothers having lived twenty eight Years, and having been taught Muſick, *&c.* makes it hard to ſuppoſe the Relation fabulous.

M. Hence, I think, we may account why more of the human Species are deformed or monſtrous, than of any other Species: For being weaker both before and after Birth, and depending longer on the Care of others, they muſt be more liable to Accidents. From theſe Conſiderations I can eaſily believe, that monſtrous Productions happen from ſome external Cauſe or Violence.

LXXIII. *P.* This then prevents in a great Meaſure what I was going to ſay; and will help you to account for many ſtrange Appearances of Animals, bred in ſeveral Parts of the Bodies of other Animals, without allowing either equivocal Productions in Nature, or a Want of Superintendance in the Formation of the Bodies of Animals. Worms of an unuſual Length and Shape have been bred in the Inteſtines of ſome Perſons; which, in other Circumſtances, muſt have been of the ſpecifick

ſpecifick Size and Figure. Inſtances hereof you will meet with in Authors of unqueſtionable Veracity: But it would indeed be trifling, to be more particular here in the Application.

M. This Way of accounting for what may appear *monſtrous* is both natural and intelligible.

P. Conſider, that either the Vegetation of animal Bodies muſt go on, notwithſtanding *unuſual Poſitions*, or the Diſturbances the *Semina* may meet with; or, that the *Author of Nature* muſt ſuſpend *the Courſe of Nature*, whenever ſuch Accident happens, which muſt make the Courſe of Nature quite precarious. In ſhort the *Exception* here is in Conſequence of the *general Rule*.

M. I ſee very well, that the State of the human Body itſelf would be altogether uncertain, if, as often as any external Violence happened, either before or after Birth, the Growth and Vegetation of it were at an End. Every *Hurt* or *Accident* muſt then prove mortal. It is as if we ſuppoſed a Tree would not grow, but according to one preciſe Shape.

P. Theſe are liable to ſo many external Violences, that we find a diſtorted Shape in them, is not reckoned at all extraordinary: And if we conſider preternatural Formations of any animal Body in this View, they are ſo far from being Arguments againſt a Providence, that (as has been ſaid) taking in the ſupervening Accident into the Account, they are produced in Conſequence of the ſettled Courſe of Nature. — It is, perhaps, ſcarce worth

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worth while to take Notice, that the *Similitudes* between Parents and Children might be alledged as an Objection to some Things we have said: But the Dissimilitudes prove as much, at least, the one Way, as the Similitudes do the other. Both are casually superinduced, long after the *seminal Stamina* are completed, and by quite a different Cause from what such Objection would suppose. If it were not so, all the Individuals of every Species would be exactly like.——And now, I hope, we have done for this Time, *Matho*.

M. I am just ready to leave you, *Philon*; and after this Conversation, wherever I am, I shall always be less alone, than otherwise I should have been.

P. All we have said can only serve to set your Thoughts at Work, and put you upon making your own Observations.

M. I find already, that is no small Article in any Part of rational Life: And on this Account I was resolved to ask your Advice, if it might not be to the Purpose to get a Set of good *Microscopes*, and to learn to manage them myself.

P. It would not, indeed, be improper: Your Eyes are good, and to make Observations, though equally instructive with the most serious Study, is as pleasant Diversion as any young Person can desire: For the Microscope, *Matho*, is really like an *Inchantment*; it opens new Prospects in the most ordinary and neglected Objects, and often discovers surpriz-

ing Sights, where we thought there was nothing but what we knew. In Vinegar, where one expects to see nothing besides the Liquor itself; or in Water, wherein Ginger, Pepper, or some such hot Spice hath been steeped, the Microscope discovers inconceivably small *Animalcula*, of different Sorts, swimming up and down: Whence it is reasonably inferred, that the Air itself is, in the Summer Months, full of invisible living Creatures. The fifth Conference.

M. How is it known that these Animalcula were not originally in the Water?

P. If the same Water be kept covered from Communication with the open Air, no such Creature can be seen in it. And such diminutive *Things* could neither creep, nor move upon any dry or solid Body: So that they could have no Motion, but in the Air, or in some Liquor.

M. That Consideration seems to put the Point out of Doubt. But what should bring them to Water thus prepared?

P. The strong *Odor* invites them to reposite their Eggs in such Liquor.

M. This distresses the Imagination, to conceive an organized Body, with Difference of Parts fit for Life and Motion, wrought up in such narrow Bounds. You had Reason to say that the Beginnings of animal Life are carried far beyond the Reach of our Faculties. And then how small must the *Particles of Odor* be, which they can smell! Whether we go upward or downward, in the Works of Nature, all

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all is amazing! We may know a little about the Middle, but cannot come near either of the Extremes.

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Conſequences from the Subject of the laſt Conference. That it doth not belong to any Power to make Matter a ſelf-moving Subſtance: Such Suppoſitions proceed from our Ignorance, in joining together in our own Imagination inconſiſtent Effects. The Folly of appealing to Omnipotence in ſuch Caſes, or where other Proofs may be had, which are more within our Reach. Hence all the Motions in the Univerſe are owing immediately to an immaterial Cauſe. Of the ſeveral Motions in the animal Body, on each of which Life depends. The various Motions produced by the Deity in vegetable and animal Bodies, may be called mechanical, *becauſe of their Conſtancy and Regularity, and the infinite Fineneſs of the Effect. Of ſpontaneous Motion. The greateſt Part of ſpontaneous Motion mechanical in this Senſe. Two diſtinct Powers, or two different* Motives *concur to produce ſpontaneous Motion. Of the human and brute Soul. The moſt perfect Brutes irrational: Nothing more*

more confirms this Opinion, than the Objections that are brought against it. Of Reason *and* Instinct. *The wonderful Nature of Instinct. The Connexion between the vegetating and animated Parts of the Scale of Being. The Misery it must be to Mankind, if Brutes reasoned. The different Structure of Body does not make the human Soul rational. Eternal Truths discover to us, immediately and by themselves, an eternal Intellect,* &c.

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LXXIV. *M.* I AM afraid you'll think me a little inconstant, *Philon*; since sometimes I visit you in a few Days, and sometimes not till after several Weeks.

P. One who knows the Use of Time so very well, *Matho*, will always be profitably employed, and in one Place as much as another: But I hope you have been well all the while.

M. Well, I thank Heaven; and so much the better, as our last Conference has afforded me great Pleasure since I left you.

P. In what, pray?

M. When I walk abroad, I can hardly see any Thing, *Bird*, *Beast*, or *Vegetable*, but what offers me some Subject to exercise my Thoughts upon. You have directed my *unmeaning Curiosity* to a consistent End; and I hope I am less in Danger, than formerly, of falling into that irksom State of growing weary of myself.

P. The

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P. The Mind of Man is an *active, reſtleſs Being, Matho*; and it is of no ſmall Conſequence in rational Life, (as you obſerved) to furniſh it with proper Matter to work upon; to accuſtom it betimes to fall eaſily into a conſiſtent and uſeful Train of Thought: But it appeared from many Things you ſaid when laſt here, that this Occupation is not new to you. I muſt in Juſtice therefore refuſe the Compliment you make me. *Curioſity* is an excellent Quality, which Nature does not make ſo ſtrong in the human Mind, and eſpecially in young Perſons, for no Purpoſe: And I ſee, from the preſent Inſtance, that it ſometimes finds out its own Way.

M. It will always be better for Direction in any Caſe, though I own it is a fine Handle; and by it there is a certain Dexterity, I conceive, in leading People, ſo that they ſhall ſeem to guide themſelves: This, I ſuppoſe, is the natural Uſe you meant might be made of it?

P. I either meant it, or you have put a right Meaning on what I ſaid at a Venture.

M. Pray be a little more explicite; the Point ſeems to deſerve it.

P. Things appear to me thus. We are at firſt innocent Creatures, without Experience, but with an unbounded Stock of Curioſity. The Mind is then in the ſame State, as the Body was in the Womb, capable of being moulded either crooked or ſtraight. We are attentive to what paſſes within our Obſervation. Hence the firſt Examples have a prodi-

gious

gious Influence upon us. They are the Models held out to our Imitation in like Circumstances. These we must think just and natural, as we know not another Way of Action. What is told us we firmly believe, being without Suspicion and without Art. From this you will see how early the human Mind may be tainted. If after this we endeavour to reclaim young People, once thus perverted, only by the Methods of *Pain* and *Terror*, we treat them not like reasonable Beings, and are severe on others for our own Fault. If they should escape this first Danger, and the *Infant-Habits* of Virtue (if I may be allowed the Expression) are once settled, that *strong Curiosity*, so natural to a Mind unfurnished, gives us all the Command over them we ought in Reason to desire. All the remaining Part of Life has less Hazard in it (bating particular Accidents) as the young Person has now some Stock, and can do something in his own Defense: But a Child is at the Mercy of every bad Example. ——Thus much in Compliance with your Desire. To pursue Things more minutely would be needless.

M. From your beginning in this Manner, I easily see through the whole; and it seems you charge the future Miscarriages of young People on the Mis-conduct of the old.

P. The more I may be mistaken in this Case, so much the better. But to return to our Subject.——As you have been considering the Objects that fell under your Observation, what

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what are your Thoughts now of that Variety of Species and Individuals, which are wrought out of the same common dead Substance?

M. If my Capacity were greater, I find my Admiration must be heightened in Proportion: But concerning this Particular, I have a Question to propose to you.

P. I shall be glad to hear it.

M. If the Reason, why the Deity hath shewn so much *Power* and *Wisdom* in the Fabrick of the Universe, was to represent these Perfections to rational Beings, legible in such an inert Thing as Matter; and since we are not able to fathom the Depth and Variety of the Contrivance, nor the Extent of the Power employed in the Works of Nature; pray tell me for whose Use and Contemplation are those hidden Miracles reserved? Many of these in the cœlestial Bodies we cannot reach, because of the Distance; and many more, though near and round us, are as inaccessible, because of the Multiplicity and concealed Fineness of the Art. And yet it must be inexpressibly pleasing and instructive to the *rational Nature*, to see and admire these secret Mysteries of Wisdom and Power: And therefore to wish to know them, seems not to be an idle Curiosity, but a rational Desire. We can have no reasonable Desires, I think, but what were designed to be gratified.

P. You

P. You put the Question pretty strong, *Matho*; and it seems to import something not commonly attended to. I agree with you, that such Retirement of Art from mortal Eyes cannot be without some great and rational Purpose: We can discover nothing as far as our Faculties enable us to go, but what is usefully and wisely designed: And to imagine that all beyond our Reach was void of Purpose and Design, would be an absurd and injurious Notion. I likewise agree with you, that the Desire of knowing those hidden Operations of the Power and Knowledge of the *Creator* must be rational: We are inevitably led into it, as we improve our rational Faculties. To this alone are owing all the late Improvements in the Knowledge of Nature. It would be a strange Degeneracy in a rational Being, not to wish (at least) to know those Discoveries, and after them others, *&c.* But it may perhaps be more proper to think of this afterward; in order to draw from it something solid and justifiable in right Reason.

M. Let it be so.——

LXXV. To pursue then the Subject of our last Conference; besides the Art in moulding and contriving such a Diversity of Things out of the same common Substance, the manifold Motions, which we see continually excited in them, seem to merit a more particular Consideration. I do not mean the Motions of

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the heavenly Bodies; theſe are ſo plainly the immediate Work of the Deity, that no Man can doubt about them: Nor do I mean the leſs perceptible Motions in Vegetation, though theſe are more intricate: For there is nothing here except inert Matter; no living Creature to aſſiſt in producing the Effect. But the Motions of Men and all Sorts of Animals are extremely more difficult and perplexing.

P. If you are ſatisfied that Matter reſiſts all Change of its preſent State, you muſt be equally ſatisfied that all Motion is excited in Matter by an immaterial Cauſe.

M. I am fully convinced of it; but it is ſtill too general, and does not touch the Caſe I want to be informed in.

P. I am afraid it will fatigue you, *Matho*, to ſpeak particularly of the ſpontaneous Motions of Animals, or even of that which is in Vegetation; as a tedious Diſpute would be raiſed on this Head, which it is ſcarce worth while to enter into; and yet it requires ſome Trouble to diſcuſs it.

M. You take the ready Way to make me more inquiſitive; I would not willingly leave an Objection behind me; and I thought I had already gone to the Bottom of all Diſputes concerning Matter. Its Inertia or Inactivity is not denied.

P. Not directly; but ſome have had recourſe to the Power of an *Almighty Being*, to beſtow on Matter, if he pleaſed, not only the

the Power of Vegetation, but also of Motion and Thought.

M. It is meant, I presume, that Omnipotence could have made Matter a self-moving Substance?

P. And a self-directing Substance too.

M. If it moves itself, it must likewise direct itself; the one includes the other: Motion in no Direction is not to be understood. And then, I suppose, it must be maintained that every Atom is an intelligent Being: For Power without Intelligence is but *mere Temerity*; and *blind unguided Motion* (as you shewed me before) could produce nothing but infinite Disorder and Confusion.

P. It is not said that every Atom must be an intelligent Being; though the Argument you advance must bring this Hypothesis, I think, to that Conclusion.

M. If every Atom does not direct itself by its own Intelligence, it must be supposed to move itself by its own Power, and to be constantly directed by a superior Power and Knowledge. Does this save the Deity any Trouble?——Besides, every Change of Direction requires a Force to be impressed, as much as the first exciting of the Motion. Does not this suppose a Force to be impressed on Matter by an immaterial Cause, while yet it is supposed to move itself, without an immaterial Cause? This seems to be inconsistent. Could a Body give itself the constant Change of Direction, in describing a circular Orbit

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round a Center, on this Suppoſition, more than if it were ſuppoſed void of ſuch Power?

P. Things are not conſidered in this minute Manner; nor is the Suppoſition extended to the Motions of the Planets.

M. And yet the Motions of the Planets are far more ſimple and uniform than the Motions of Animals, or the Motions in the Vegetation of Plants. If Matter could perform by itſelf the latter Sort of Motions, could it not much more perform the former? —— And then might it not do all that is done in Nature? And laſt of all, is this any Thing leſs in its Conſequences, than laying aſide the Deity altogether?

P. But you do not conſider, *Matho*, that Matter is ſuppoſed to be endued with this Power by an *Almighty Being*.

M. But how does one, who thinks Matter any way capable of all this mighty Power, know that there is an Almighty Being, or any other Almighty Being than Matter, if I may ſpeak ſo without Impiety? If we once ſuppoſe it poſſible that Matter may do all that is done in Nature, we loſe after this all the Arguments for the Exiſtence and Providence of a Deity, taken from the Order and Government of the material World; becauſe Matter may do all this, and might have done it all from Eternity: Nay, we loſe all Arguments taken from any Thing whatever, becauſe Matter may be a *thinking Being*.

P. It

P. It is not supposed that Matter may do all that is done in Nature; nor is it intended to carry the Argument so far.

M. If Matter may have the Power to form a *Plant*, or an *Animal*, or to *think*; what greater Effects are done in Nature? Nor does it depend on one who frames a Supposition, to settle how far it should be carried; he ought rather to consider how far an Adversary may carry it by legitimate Consequences.

P. But still it is asserted that this Power could only be imparted to Matter by an *Almighty Being*.

M. Then you must prove an *Almighty Being* prior to this Power, which is allowed possible in Matter; that is, without having recourse to this Power, which is just what I said before. You must likewise prove it utterly impossible that this Power, which, it is supposed, may be in Matter, should belong to the Nature of Matter itself. That is, as it appears to me, you must shew an Inconsistency between the Nature of Matter, and this Power, and yet suppose them consistent at the same Time, unless you would say that Matter endued with this Power loses it's Nature.

P. You have at last gained the Point, *Matho*, and are certainly in the right. If we once suppose an *Almighty Being* to have endued Matter with this all-performing Power, we cannot, after that, make use of this Power, which we allow may be in Matter, as a *Medium* to prove the Existence of that Almighty Being. This is called a *Circle* in reasoning;

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or the Suppoſition that the Deity does this is the only Proof of his Exiſtence in ſuch Hypotheſis. Nor (as you ſubjoin) will they find it eaſy, after granting that this Power may be conſiſtent with the Nature of Matter, to ſhew it abſolutely impoſſible to have belonged to the Nature of Matter originally. Which, nevertheleſs, is the only Method they have left to ſhew a different Origin of the Power.

M. Beſides, this ſeems to me to ſet the Almighty Power of the Deity, and what I take to be demonſtrative Truth, at Variance. Would not appealing thus to Almighty Power affect all Truth?

P. Carried to the greateſt Height it would: But it is impoſſible to ſet the Power of the Deity in Oppoſition to Truth. You may perhaps ſee hereafter, that to ſet the Power of the Deity at Variance with Truth, would be to ſet the Deity at Variance with himſelf.

M. To bring in Almighty Power then, where other Proofs may be had, is to leave the Methods of Knowledge within our Reach, and raiſe Methods of Knowledge above our Capacity. This can have no other Tendency than to keep the Point from ever being determined.

P. The Obſervation is juſt; it is by the Light of the Sun we ſee all other Objects: But looking directly at the Sun himſelf dazzles our Eyes, and hinders us from ſeeing what we might perceive by his reflected Splendor. However, as the Suppoſition was raſh and ill underſtood, it is needleſs to dwell longer on the Examination of it.

M. Nay,

M. Nay, *Philon*, I beg you would not leave it so abruptly. I have hitherto only seen the bad Consequences of it, but not the formal Way how to obviate them.

LXXVI. *P.* In order then to perceive the Unskilfulness of appealing to Almighty Power in such Cases, we must go a little farther back, and observe, that some of those People called *School-men* have been foolish enough to make it a Question, *Whether the Deity could not perform a Contradiction?* This, indeed, if true, would affect all Truth, and introduce an universal Scepticism, by calling in the Help of Omnipotence! For if a Contradiction could be true, it could not be the Mark of what is false; and we could not be sure but that it might be true in every Case. Nay, two contradictory Propositions might (for the same Reason) be both true: And then every Thing might be both true and false. In which Case all Truth is lost. This is the Issue of bringing in *Almighty Power* to such a Purpose! Now, with respect to such Sort of Suppositions, the Case stands thus.——An Almighty Being can certainly perform whatever is the Object of real Power: But if the Performance of any Thing be repugnant to itself, or if one Part of the Performance supposes the Non-performance of the other; as for Instance, to cause that any Thing should exist, while it is not; or to make a Thing to be, and not to be, at once; or to make a *Part* greater than the

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Whole, of which it is only a Part, *i. e.* to make it a Part, and not a Part, at the same Time: I say, if the Performance of any Thing be thus repugnant to itself, it is not the Object of any Power, but only an absurd uniting of *inconsistent Acts* in our Conception; or rather, the expressing their Union in our Language; for such Repugnancies cannot be conceived.

M. This Solution is both rational and satisfactory; for that would be to demand that the Deity should not do a Thing, while he does it; or make a Thing both *nothing* and *something* at the same time: An Absurdity more like the wild Ravings of a delirious Brain, than Reason or common Sense.

P. It is, indeed, to bid the Deity, who is the *Supreme Reason*, shew himself absurd, or make himself a Liar, or destroy his own Power, or contradict his infinite Perfections, or join our Folly to his own Omnipotence. What else is it, when they suppose the ignorant Inconsistencies of their own Fancy the Objects or the Measures of infinite Power and Wisdom?

M. And this silly Mistake, I presume, is at the Bottom, whenever we seem to doubt, whether the Deity cannot perform a Contradiction?

P. You see it must.——Now, to come to the Difficulty, if you can shew a Repugnancy in the Supposition, That Matter should of itself change its State from Rest to Motion, or from Motion

Motion to Rest, or give itself a new Direction, the Thing is done, and you may justly infer, that whatever Motions exist in Nature were produced, or are renewed, by the Power of an immaterial Being, without leaving a Possibility for a contrary Supposition.

M. That, I apprehend, is, in effect, already done. It was shewn, that Matter, instead of effecting a Change of State in itself, necessarily resists all Change of State, as it is a solid Substance; and that this Resistance to a Change of its present State is the only Means whereby it can be made to do any Thing, or be of any Use in Nature. For when we supposed it not to resist, we saw it could do nothing for want of Force or Strength to continue in its Motion, or in its Rest. It could sustain no Force or Impression, and therefore it could not gravitate, or have Tendency to a Center. Tendency to a Center supposes a determined Force impressed upon, and retained by it, which would carry it thither. It could not bear the Shock, or the Contact of other Matter; therefore it could not sustain that constant Impression which is in the Cohesion of Parts. Each Side would yield to the Impression, or rather without bearing the Impression, till the whole Substance disappeared, or was really destroyed at the very Approach of Force; for the Action in Cohesion is that which effects the Solidity of Matter. So that solid Substance itself does not remain on this Supposition. There is nothing but the *Phantom*, the *Shadow*, the *Name*

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Name left; ſomething as impaſſive, and as far from Matter, as empty Space itſelf is. In ſhort, ſince all Action of Matter upon Matter, or of *immaterial Power* upon Matter, ſuppoſes a Reſiſtance between its Parts, there is nothing here left, which immaterial Power could work upon, or in which it could produce any Effect; nothing remains in material Nature to be *paſſive:* Or rather, the material Univerſe diſappears. The Bodies of Men, Animals, and Vegetables, all thoſe Wonders you ſhewed me at our laſt Meeting, are loſt: There could be no Power in moving, no Act in forming ſuch an endleſs Variety of different Pieces of Workmanſhip, out of a Subſtance which is not. Does not this Suppoſition cancel all the Inſtances of Power, and Wiſdom, and Goodneſs, which led us into the Knowledge of theſe infinite Perfections in the Deity?

P. It makes terrible Work in truth; and you run the Conſequences very juſtly.

M. The Reſiſtance of Matter, therefore, cannot be leſſened, or taken away, without leſſening, or taking away the Solidity or Uſe of Matter. Contrarily, we ſee that the Reſiſtance of the Parts of particular Bodies was powerfully to be increaſed and made ſtronger, that they might have Firmneſs and Strength enough to ſerve for various Purpoſes. I cannot forget the Confuſions which you ſhewed me, in our firſt Conference, would follow, if all Bodies were hard in Proportion to their Bulk, or ſoft as they are little; or if all Bodies

dies were equally *brittle*, equally *tough*, equally *yielding*, or *fluid*. Now if there could not be different Bodies, or Bodies useful for different Purposes, but by thus superinducing different Degrees of Resistance, Hardness, or Tenacity, above the *general Resistance*, which cannot be increased or lessened, but with the Solidity of Matter: We may from thence see how necessary this last Sort of Resistance is, that Matter might be fit for any Use, or, in effect, be solid Substance. From all this, and more that might be added, it appears to me, that taking away the Resistance of Matter to a Change of its State, is supposing the Substance itself to be destroyed. The fifth Conference.

LXXVII. *P.* You need say no more; the Point is undeniable, and beyond Controversy. ——Now these Things being premised, let me ask you, could this solid Substance, which thus necessarily resists all Change of State, (whether of Rest, or moving uniformly forward) *not resist?*

M. It could not certainly *not resist*, (if such Manner of speaking be proper:) For this is to ask me, *If a Thing could be, and not be, at the same Time?* A Contradiction in Terms, the Performance of which is not the Object of any Power, and could imply no Perfection. That Matter should not resist a Change of its State, the Substance ought to be destroyed: And if the Substance were destroyed, surely it could effect nothing by not resisting.

P. But

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P. But could not this resisting Substance, by some Means or other, effect a Change of State in itself?

M. By what Means do you conceive it might change its State? Unless your Question were more particular, it cannot receive a distinct Answer. And if the Question cannot be put, without supposing a Contradiction, it ought not to be put at all.

P. What if an *Adversary* should say, that Matter might change its State, not indeed by Resistance, but by some contrary Force or Tendency?

M. What should give it this Force or Tendency? In what Direction should the Tendency to Motion be? A Tendency to move in all Directions at once is absurd; and a Tendency to move in one particular Direction requires a determining Cause. An Effect without a Cause is repugnant. Is it supposed to have this Tendency *always*, or at *some times* only?

P. You are too particular and minute, in enquiring into every little Circumstance.

M. Then, it seems, I must both frame an Adversary's Objection, and answer it.—Let us suppose then a contrary Force or Tendency in Matter, and the Consequences will be, that these *two contrary Forces*, the one of resisting a Change of its present State, and the other of changing that State, should have a Struggle in the same Substance, which should prevail; though, by the Way, no Man can, I think, conceive

conceive this possible. The stronger of these Forces therefore must overcome the weaker, and so that one Force only would remain: Or if both Forces were equal, they must mutually suspend, or destroy each other; and thus no Force, not even that of resisting, would remain. Thus we see *that the same Substance is not capable to be the Subject of two contrary Forces or Tendencies*; and the Result of the Supposition is, *One Force only or none at all.*

P. What if they should have recourse to the *Power of the Deity* at this *Pinch?*

M. What is it they would demand of the Deity in such a Case?——That which Reason denies them: That he would *do*, and *not do* the same Thing, at the same Time, for their Sakes? For this is really their Request at the Bottom. They join inconsistent Notions in their own Imagination, and then beg of the Deity that he would bear them out in this Distress: That he would *set his Power in Opposition to Truth* for once, to gratify those who are so respectful as to appeal to his Omnipotence. The Deity, as you said, is the *supreme Reason*, and not a *Refuge* for Absurdity. Nor is it a simple Absurdity, since they contend, not only that a resisting Substance should *not resist*; but that while it resists, it should overcome its own Resistance: That is (since Matter cannot admit a contrary Force to this) that the *Means* of overcoming its Resistance should be the Resistance itself.

P. As

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P. As it appears to me, *Matho*, you have sifted the Argument in all its Shapes: However, let us suppose for once, if you please, that the *two struggling Forces* could, by some strange Power or other, be planted in Matter; the *one* of persisting in, and the *other* of always changing its present State; that we may see the Result of the Controversy on this Supposition also.

M. With all my Heart, though I fancy it cannot be brought to any other Issue than before. For as both Forces are supposed to act always, either the Force of persisting in the same State must prevail, and so the opposite Force should be without Effect; or this last Force must prove the stronger, and so the Body could have no Force to remain in the same State, without a constant Assistance from *something immaterial.*

P. You brought the point to the same Issue I remember in a like Case before.

M. It was so; for they who maintain this Supposition should thus shift Sides in the Debate; *viz.* refuse an *immaterial Power* to effect a change of State in Matter, and yet contend for an immaterial Power constantly impressed, to assist Matter to remain without a Change.

P. This would be extremely foolish to find in Matter a constant Power to change its State, and yet no Power at all to remain without a Change: For if Matter had any Sort of Power, it must be that of remaining in the same State, as a Change of State requires a different Exertion

tion of Power.——But pray, if this Force of constantly changing its State should be thus prevalent, what must the Consequence be? The sixth Conference.

M. The present State would incessantly be changing; or a Body could have no State, either of *Rest* or *Motion*, but a continual turning from the one to the other; which, whatever Way they might endeavour to explain it, must be inconceivable. For the Order of Nature, and Consistency of material Things, require some certain finite Duration of the State of Rest, or Motion. And as this Consequence would take away both *Rest* and *Motion* out of Nature at once, the thought is monstrously repugnant.—

P. Lastly, *Matho*, since the very Solidity of Matter, and therefore its Resistance, (that is its Tendency to remain in the same State) requires the constant Impression of *Divine Power*, as we saw before; we may see also that the various Changes wrought in Matter, are but the various Modifications of the same constant Impression.

M. I see the Strength of the Consequence clearly, and with great Pleasure. For if the Power of the Deity constantly put forth, be the very *Basis* of the Existence of Matter: The various Operation of that Power must be the Cause of Matter, as changing the Manner of its existing: Or if the Deity be the constant Cause of the Existence of Matter, he must be the Cause of its existing in different Manners; that is, both of its Motion and its Rest. What else in the universal Nature

of

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of Things could diverſify the Operations of the Power of the Deity, except the Deity himſelf!——I thought I had finiſhed the Conſideration of the Nature of Matter before: But this different View of the Origin and Spring of Motion; and being ſhewn how improper it is to appeal to the Power of the Deity, where other Proofs may be had; does more than reward the ſmall Pains I have taken in going along with you.

LXXVIII. *P.* You will now ſee with Eaſe and Certainty, what we are to conclude concerning the Cauſe of all Sorts of Motions in Nature, excepting the ſpontaneous Motions of Animals, which are indeed more various and intricate, as you obſerved, and require a Difference of Conſideration from thoſe of inanimate Matter.

M. The Cauſe becomes now too plain to admit of farther Diſpute; and the Inſtances of Motion too many to be reckoned up. The ſeveral Motions in the *Heavens*, in the *Earth*, in the *Waters*, in the *Clouds*, in the *Air*, which we breathe, are the immediate Work of the Deity. When we reflect that Life, and the Pleaſure of it, depend on the Changes which thoſe Motions produce, we cannot think upon them without the higheſt Reverence and Gratitude.

P. You have Reaſon to ſay ſo, ſince any one Species of Motion could not be taken out of Nature, without our feeling the Change greatly

ly to our Disadvantage. We little consider that the *Air* and the *Water* might as readily stagnate, as be moved: Rest requires no Variation of Power. These *Elements* then would become *baneful* and *deadly*. If the Vapours did not rise, Rain could not fall, nor Springs flow, nor Vegetation continue. As to the Motions of the greater Bodies in Nature; every one will easily allow that our Earth, for Instance, might have had no Motion at all, instead of those two wonderfully contrived Motions, which we mentioned before, and which bring about such pleasant and comfortable Vicissitudes. Besides all these, the Life of Man and Beast consists in manifold Motions, constantly performed in the Body, without their Knowledge or Participation: It is so easy to conceive after what manifold Ways these might be interrupted, that it is miraculous how they are continued. If our Life depended only on one Sort of Motion, we should soon forget that we were dependent at all; when we so little remember our manifold, and really innumerable Dependences. So that I agree with you, *we cannot seriously reflect on the several Species of Motion in Nature, without the highest Reverence and Gratitude.*

M. Pray let me know something concerning those internal Motions constantly performed in the Bodies of Animals, without their Knowledge and Participation?

P. I cannot speak of those Things, *Matho*, of which I know so little, without injuring

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the Subject; and therefore I cannot convey to you thoſe juſt and lively Notions, nor raiſe in you that Admiration, which the Particulars deſerve.

M. I do not expect a juſt Repreſentation of thoſe Matters; but only ſuch general Hints, as may let in the firſt Glimpſe of Light on the dark and ignorant Mind.

P. Why then to huddle up the Thing at once, All is Motion in the animal Body, from the firſt throwing in the *Aliment* into the Stomach, 'till it is at laſt, by various Changes and as various Ways, conveyed to all Parts, in Order to recruit and maintain the whole: Nor even there does the Motion ceaſe, for thoſe Supplies are quickly thrown off again, and the Parts are conſtantly to be ſupported in the ſame Manner.

M. I remember you told me before, that *Perſpiration* occaſioned a conſtant Waſte and Decay of the Body, and I am apt to believe it. For if, in adult Perſons, the Parts were conſtantly recruited from the Aliment, without Loſs of what they had formerly received they muſt ſoon grow to an enormous Bulk, and become an intolerable Burthen: And if they loſt nothing, they would not need, I think, any new Recruit, or the Animal require Food.

P. What you ſay ſeems reaſonable; the former Supplies are thrown off, whether the Parts receive new Support, or not: You ſee how ſoon a Perſon may be emaciated by Sickneſs

or

or Diſeaſe, and worn to a very Skeleton. And either the ſolid Parts of the Body thus fly off by inſenſible Perſpiration, or they muſt bear a leſs Proportion to the Fluids than is commonly ſuppoſed: For in ſuch Caſes, the brawny, muſcular, and firmeſt Part of the Fleſh diſappears.

M. Methinks I perceive from this, how the Body might be ſupported without Food.

P. The *Author of Nature*, *Matho*, can eaſily ſuſpend the Courſe of Nature, which he inſtituted arbitrarily, without receiving Laws from the Materials he wrought with. An immortal Body is no more a Paradox, than an immortal Soul.——

M. But you made a wide Step, from the firſt throwing in of the nutritive Subſtance, to its being at laſt thrown off in this Manner: Tell me ſomething of the intermediate Changes and Motions. What becomes of it after it is thrown into the Stomach?

P. Being bruiſed with the Teeth, and mixed with the *Saliva*, it paſſes to the Stomach, where it is digeſted.

M. How is Digeſtion performed?

P. The groſſer Parts of the Food are ſtill made finer, by the conſtant *Attrition*, or *Rubbing* of the Sides of the Stomach upon them; 'till by this Action, by the natural Heat, and fermenting Juices, they are concocted and brought into a new Form, fitter for moving through the narrow *Meatus's*, which they muſt paſs, in order to be conveyed to the Blood.

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M. How is it known that the Stomach hath ſuch a conſtant Motion as this?

P. Such a Motion is neceſſary in the Stomach on another Account; namely, for thruſting out the Aliment, ſo digeſted, into the *Inteſtines:* And *Nature* attains more Ends than one, by the ſame Means. *Granivorous Birds*, being without Teeth, for Comminution of the Grain, ſwallow little rough Stones, and Gravel, to aſſiſt this Grinding or Attrition: It is this Action (they ſay) which occaſions the Pain we feel in Hunger; and ſome have computed the Force of the Stomach in this Action to be incredibly great.

M. By what Means is this conſtant Action of the Stomach continued?

P. I might tell you of the *Elaſticity* of its Fibres; or their alternate relaxing and reſtoring themſelves; but it is the ſhorter Way, to own I do not know.

M. And as inſtructive too, I think, as to tell me that the Action of the Stomach is owing to the Action of its Fibres.——What becomes of the digeſted Aliment, when it is thrown out into the Inteſtines?

P. It is thrown out gradually: The feculent and excrementitious Parts are protruded, by *another conſtant Motion*, along the various and mazy Folds of the Guts, to be at laſt quite thrown off; and by this Action, the finer and nutritious Subſtance is forced into certain ſmall Veins (called *lacteal Veins*) appointed for receiving it.——But here again, *Matho*,

we

we are in danger of becoming too minute and particular; which is neither your Business nor mine.

M. I shall have done immediately; only tell me what Sort of a Motion this of the Guts is?

P. You have observed an Earth-worm when it creeps on the Ground?

M. Often.

P. It stretches itself in Length, and becomes small, by extending its *longitudinal Fibres*; and then contracts itself, and becomes grosser, by dilating its *annual Fibres*: Such a Motion is that of the Intestines, only it is equable and constant, so as to become *wave-like*, or *undulatory*. You may perceive it in some transparent Animals, by the Help of the Microscope: And certainly nothing can be more adapted, both for carrying the *Fæces* gradually forward, and forcing the *Chyle* (as it is called) or alimentary Substance, to ascend in the *lacteal Vessels*.

M. It is, indeed, wonderful, and kind, that a Motion, on which our Life so nearly depends, should be constant. But why should the Intestines fold and turn so much, rather than go on in a straight Course?

P. They are about six Times as long as the whole Body; that is, about six and thirty Foot in a Man; and artfully folded up in a small Space, for this very Purpose, that all the nutritive Substance, or *Chyle*, might in some Place or other be taken up into these lacteal Veins,

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which are every where placed to receive it in passing.

M. This is a notable Contrivance!——For I conceive these lacteal Veins could not have been large enough to take it up all at once, or in one Place, without taking up some of the *Fæces* along with it; which must have obstructed the End of their Separation.

P. So slender are these *first Lacteals*, that they do not exceed the Capacity of *capillary Arteries.*

M. What becomes of the *Chyle* after this? or whither is it conveyed?

P. It is conveyed by those numerous Veins into one common *Receptacle*, and thence ascends by one Passage to the *left subclavian Vein*, (as it is called) as a lesser Stream falls into a larger: And afterwards it is carried with the circulating Blood, to all Parts of the Body.

M. I have seen the Circulation of the Blood, *Philon*, in the finny Tail of a little *Tad-Pole*; and certainly it is a Motion full of miraculous Power! So many Streams of Liquor constantly running in a Space not so large as a Pin-Head! What you said was very just; *The Microscope is like an Enchantment!* From what you say of the *Chyle*'s ascending to the left Subclavian Vein, I would ask how a Liquor can flow upward: But pray shew me first, in what Manner this Circulation is performed; for though I beheld this Wonder with my Eyes, I saw it but in one Point.

P. To give you some imperfect Idea of it you must know, that the Blood is carried from the *Heart* by Arteries, and returns to it by Veins. The *Arteries* proceed from one great Trunk, called the *Aorta*, issuing from the left Ventricle of the Heart. This is divided and subdivided into innumerable Branches, and capillary Extremities, which terminate in all Parts of the Body, external and internal, wherever it is necessary that Blood should be conveyed, or the Parts recruited. The *Veins* begin where the capillary Arteries end; that is, over all the Parts of the Body; and returning, unite still in larger Channels, till at last they all meet and form the *Vena Cava*, which opens into the *right Auricle* of the Heart.

M. Thus far I have a general Notion.

P. The Heart, from the first Moment of Life, to our last expiring, is in a constant alternate Motion, of the Constriction and Dilatation of its Cavities, which are called its *Systole* and *Diastole*.

M. I need not ask you how this alternate Action is continued for eighty or ninety Years? I know what Answer you would give me.——

P. At every Constriction of the left Ventricle of the Heart, the Blood is expelled with great Velocity into the *Aorta*, which you may instantly perceive in several Parts of the Body by the *Pulse*, of which there may be about fourscore in a Minute. And thus the alimentary Parts of the Food are carried by innumerable Streams to all the Parts of the Body,

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to recruit the Waſtes occaſioned by Perſpiration.

M. I conceive it plainly.

P. Having diſcharged this office, the Blood returns again to the Heart, and is diſcharged into its right Auricle, while that is in its *Diaſtole*, or Dilatation.

M. But I want to know how the Blood flows upward in the aſcending Veins. Water is raiſed up to the Atmoſphere in the Form of Vapor, which cannot be the Caſe here.

P. This I cannot tell you. Many are the Efforts that have been made, to find out a mechanical Power for this Purpoſe; and if they have ſucceeded, ſo much the better. Only thus much is certain, wherever a Liquor runs upward, there are *Valves* diſpoſed in proper Places, opening in the Direction of the flowing Current; but which muſt ſhut if the Liquor ſhould move backward.

M. All this is aſtoniſhing! Here is not one, but numberleſs Circulations, conſpiring to form one great Circulation!

P. Conſider this Figure a little.——It is the Syſtem of the Arteries in the human Body; or, of as many of the principal Branches of them as can be expreſſed without Confuſion.

M. I ſee ſome riſing to the Head, Neck, and Shoulders, and extending to the Arms and Hands; and others ſpreading over the Body, and running down to the Thighs, Legs, and Feet: They appear vaſtly numerous.

P. And yet the ten thouſandth Part of them is

is not, and cannot be represented. Their Capillary Extremities cannot be seen in other Circumstances, than you perceived those in the Fin of the little Animal. The fifth Conference.

M. It must certainly be so, if they terminate as numerous in every little Point, as those I beheld there.

P. There is by far more Difference between the greatest and the least, than between the largest *navigable River* and the smallest *Rill.* ——Here is such another Figure, expressing the general Position of the larger Veins.

M. I observe in this almost the same Order and Disposition as in the former; so that one could not know which were which, unless better informed of these Things, than from mere verbal Descriptions.

P. If then the Body were transparent, or the Sense acute enough to perceive all those innumerable Streams constantly flowing, *from all Parts, and to all Parts*; what Sort of a Sight do you think, or what various Motions should we behold!

M. The very Thought fills the Soul with Surprize! The Body itself would then appear a System of ever-flowing Currents, more various and wonderful than those in the largest Kindom upon Earth.

P. All this Motion is as real as if we constantly beheld it with our Eyes.

M. I have often thought, *Philon*, since I began to consider these Things, what ridiculous and affected Creatures the Poets are, who wish

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wish for a hundred Mouths, and a hundred Tongues, to help them to describe some paultry Fiction of their own Brain: It is only in such Cases as these, where one could reasonably wish, that one's Thought and Admiration were a thousand Times doubled, to be able to pursue *every Wonder*, and think worthily of the Power and Wisdom manifested *in any* of the Works of Nature.

P. The Occasion would be more justifiable, I confess. But we must leave this Subject, without considering the remaining Part of the Circulation; for we have only yet spoke of one half of it.

M. Pray what other Half remains?

P. The Systole of the right Auricle expells the Blood into the right Ventricle; and the Constriction of that Cavity thrusts it into the *Pulmonary Artery*; on the *Lungs* it is spread innumerable Ways, and returns by the *Vena Pulmonalis* into the left Auricle, by the Systole of which it is forced into the left Ventricle, whence it is again ejected into the Aorta, as at first.

M. What is the Use of this shorter Excursion of the Blood from the Heart to the Lungs?

P. Though all allow it necessary, the Use is disputed; it serves probably more Ends than one. The Blood was to be impregnated with fresh Air, which, by the great Pressure on the Lungs in Respiration, seems to be forced into it.——The *Respiration* itself every Body knows to be another *great*, *necessary*, and *constant*

stant Motion in the Body on which our Life no less depends, than on any of the other Motions we have mentioned. The sixth Conference.

M. The Consideration how Life is preserved, and how many different Conditions are necessary, is full of Awe and Wonder! I perceive the Truth of your Observation; that *if our Life depended only on one Sort of Motion, we should soon lose all Sense of our being dependent Creatures.*——But

LXXIX. Pray in the next Place communicate to me something concerning *spontaneous Motion.*

P. I must first acquaint you then, that those Motions we have just now been speaking of, where the Deity is the *sole Mover*, and which are so artful and regular, may be called *mechanical*, to distinguish them from spontaneous Motions, which are performed by Men, and other inferior Animals.

M. I perceive the Use of the Distinction. You call this Sort of Motion *mechanical*, not as if it were the effect of mere Matter, without an immaterial Mover (which is the common Acceptation of the Word) but to mark the Justness and Regularity of it.

P. For that Reason only.——Now, I ask you, since Matter cannot change its State, nor move itself; what are we to think of spontaneous Motion, or concerning the *Movers* that excite it?

M. This seems to me another easy Consequence

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sequence from the Inactivity of Matter: For if mechanical Motion be above the Power of Matter, spontaneous Motion, which rises above the Laws of Mechanism, is a Degree higher above the Power and Genius of Matter, and shews plainly that there is in every individual Animal, or spontaneous Creature, an immaterial Principle, which is called the *living Soul*, by which these Motions are performed.

P. You have touched upon a fundamental Consideration, which will help to clear up this difficult Affair by Degrees: For in the Motions we have hitherto taken Notice of, the Deity hath reserved both the *Power*, and the Direction of the Motion entirely to himself; or rather (to speak more truly) there was no other Being which could be the Cause of this Motion: Therefore the Laws of mechanical Motion are constant, and the Effects of it infinitely fine and regular. But as the Scale of Being was to rise, spontaneous Motion (produced by living Beings) was indeed *necessarily* to be less regular, and to produce less wonderful Effects: And yet, so far as it receded from the stated Laws of Mechanism and Regularity, so much the more doth it shew to us a different Cause of Motion, not only from dead Matter (which is no Cause) but from the Deity himself. And those Creatures which are least perfect have so much the more of Regularity in their Works, as there is more of the Deity in these Productions, than in those of superior Animals.

M. Instances

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M. Instances of this you shewed me at our last Meeting; and now I see that *spontaneous Motions* are so far distinguished from *mechanical* (i. e. those produced by the Deity) as they are more wild and irregular: Or the Power of the *spontaneous Mover* is not conducted by equal Knowledge.

P. You are right; this Want of Knowledge is a wonderful Ingredient in our spontaneous Motions; so far, I mean, as they are produced by us. The Deity hath granted Animals a Degree (a small Degree) of Power; but hath reserved the Knowledge of the Method entirely to himself. When we excite Motion in any Part of our Body, we act as blindly as the brute Creature. We attain at length a Habit of moving one Part, rather than another, according to our Pleasure; but know nothing of the secret Means by which this is effected. The greatest Philosopher on Earth is, in this respect, on a Level with the inferior Animals.

M. I never reflected upon this before; and yet the Truth of it must be perceived, as soon as attended to. We perform these Motions before we know any Thing; and the Brute performs them as well as we. And when we come to know more, that does not teach us to perform them better. All is indeed a Habit, we cannot tell how acquired: For the Brutes seem to be sooner Masters of it than Man.

P. You reason justly; and we may likewise be farther convinced that our own Knowledge has no Share in the Production of spontaneous Motion,

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Motion, in that when learned men have applied themselves with all their Industry, to discover in what Manner it was performed, how the Command of the Will is so justly executed, or by what Means the Action comes to be communicated to the immediate Instruments of Motion, they have been able to do little more than guess ingeniously, and often in Contradiction to each other.

M. This is really wonderful, and shews us, I think, that *Spontaneity* and *Knowledge* are very distinct Principles.

P. You cannot make a juster Observation; and the longer you dwell upon this Subject, you will find it the more confirmed. The brute Species, as you observed, are sooner perfect in spontaneous Motion than Man: And certainly we may allow, without Danger of going too far, that they are not quite so knowing——Now from these broken Hints, you will at length be able to observe, *That by far the greatest Part, even of spontaneous Motion, is produced mechanically*; and that the Imperfection we found before in spontaneous Motion is not in the mechanical Part of it, but only consists in this, that our Spontaneity is not directed by equal Knowledge. When I move my Hand, the *Muscles* (as they are called) which produce the mechanical Part of this Motion, act as regularly as the Muscle of the Heart, in its Systole and Diastole, where I have no Participation: Yet I cannot produce any such artful Effect, as the Bee, the Spider, or the Silk-worm.

M. That

M. That Part of the Motion must be mechanical, with respect to us, since it is not performed by our Knowledge and Direction.

P. Nay, nor by our Power neither; for as we do not understand the Contrivance, so we do not afford the Means; and a small Disorder of the Mechanism, we find hinders the Production of the Motion. So that when I move my Hand, I as little supply the motive Power, as I do the Motion of my Heart; and that is, as little as I do to the Vegetation of a Plant.

M. This Subject becomes more wonderful at every Step! Here I see again, what we observed before, when speaking of Matter, that the Deity occurs to us in every Thing, and his Power is the Spring of every Effect. It is above Expression strange, to find it at the Foundation in our spontaneous Motions.

P. It must be so in true Philosophy, *Matho*; if it appeared otherwise, I should suspect you had reasoned wrong.——And yet, notwithstanding this, it is certain that the *spontaneous*, or *living Being*, both begins, and stops the mechanical Motion, and determines it all Manner of Ways, at its Pleasure. This we are intimately conscious of, and know we are endued with such Command. When we discourse together (to pass by other Instances), the *spontaneous Principle* commands the Motions of the Organs of Speech, in the Articulation of every Syllable: So that the Words formed by this Motion and the internal Thoughts of the Mind

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Mind correspond, as if the Whole were performed by the same *Agent* and *Power*. We can scarce conceive a more easy and absolute Command, than the *spontaneous Being* hath over the Motion of the Body in this Case.

M. Indeed the Command is so easy, that the greatest Part of Mankind, I persuade myself, fancy the whole Action to proceed from the same Cause: So easy, that the spontaneous Being imposes on itself! And is at the same Time quite ignorant how the Motion is performed! This is wonderful! Nor is it less wonderful that the Deity should submit his Power to co-operate with the *spontaneous Principle* in every living Creature!

P. You see his Condescension in the Formation of the Body of every the minutest *Insect*; and in the solicitous Provision he makes for the most contemptible *Reptile*. But these Thoughts would carry us a great Way. He co-operates with all the Actions of Men: The established Course of Nature must otherwise be incessantly suspended; and yet the *Obliquity* and *Error* proceeds from our Thought and Intention only.

M. I preceive there could be no settled Course of Nature, without this *Co-operation*.

Si, quoties peccant homines, sua fulmina mittat,

is applicable here: And the Intention would not be less criminal, though the Course of Nature were constantly changed or suspended, to prevent the Effect.

P. This

P. This is a Case then, where both the Wisdom and the Goodness of the Creator is conspicuous; and yet his Justice, as our *Law-Giver*, hath full Power to punish.——As to the ready Command which the *spontaneous Being* hath over the Motions of the Body, without knowing how these Motions are performed, it is certainly wonderful: But we may easily be satisfied that the Thing is so, from a Case in some Measure parallel. A Man by the help of Machinery, or Engines, performs far greater Things than he could otherwise do; and if we suppose him ignorant of the Contrivance or Art, whereby the Machine is made to perform the Effect, but had only learn'd to move a Handle, or certain Part, by which the Whole was set a going, neither the Power nor the Knowledge of producing the Effect belonged to him: And yet it could not be denied but that the Man, by spontaneously moving this Handle, or holding it still, had the Command over the whole Mechanism, and over the Effect it produces. Just so, the *living Being*, though ignorant of the Contrivance and Mechanism by which spontaneous Motion is performed, both begins and stops it, and has a free Command over it.

M. This I perfectly comprehend. A Man who knew nothing of Musick, might for all that play a Tune, or half a Dozen of Tunes mechanically, on an Instrument so contrived, merely by turning a Handle. Which shews that a spontaneous Being may have the full

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Power of exciting, continuing, repeating, or ſtopping a mechanical Motion, which it does not underſtand. Here the *mechanical* and *ſpontaneous* Powers are quite different, and the Effect depends on both Powers acting jointly: For in this Inſtance, the Tune could not be played, if either the Man did not move the Handle, or if the Mechaniſm happened to be diſordered.

P. It is very rightly obſerved. Now, as there are two ſeparate and diſtinct Principles here, concurring to the Production of ſpontaneous Motion; ſince Matter is devoid of all Power, we ſee plainly that both muſt be immaterial, and alſo that the Power and Knowledge of the *one* is infinitely ſmall in Reſpect of that of the *other*.

M. The Conſequences of both are very clear. This Conſideration of two ſeparate and diſtinct Powers pleaſes me extremely, and agrees to Appearances, as it aſcribes the different Parts of ſpontaneous Motion to proper Cauſes. The Soul could not produce the mechanical Parts of ſpontaneous Motion, and know nothing of the Contrivance by which itſelf wrought: Nor could the Deity produce the ſpontaneous Part, and be impeded by a Defect in the Mechaniſm; nor could he feel the Pain and Impotence which the Soul ſuffers under ſuch an Impediment. Whence is diſcovered the extreme Difference betwixt the two motive Powers. If we admit but of Matter, and *one Mover* only; the Motions of Animals are quite unaccountable.

P. And

P. And therefore (as you observed in the Beginning) the Argument concludes for an immaterial Principle in every living Thing, Brutes as well as Men: Though there are other Arguments, not applicable to the Souls of Brutes, which shews separately, and upon other Accounts, the Immateriality of the rational Soul.

LXXX. *M.* Since both are immaterial, I should be glad to understand the Difference between the Brute and human Soul?

P. This is a Point, *Matho*, the Discussion whereof, as I observed to you before, is extremely difficult; for though the Answer to your Question might be given in few Words, yet Opinions entirely contrary to each other, and equally absurd, have set Men on perplexing, instead of unravelling the Subject. Some Philosophers will not allow the Brutes to have so much as a spontaneous or living Principle in them; and others will needs raise them to the Dignity of rational Beings.

M. These are in truth very contrary Opinions; but so far I think appears already, from what has been said before, that Spontaneity and Knowledge (or Reason, as I take it) are very different Things,

P. As different as most Things you can name. Few Creatures are defective in Spontaneity, after we pass those, which, like Plants, are rooted to some Place: But Reason is a Thing of a superior Nature. In Man himself

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the latter of these Principles is not near so extensive as the former.—But to come to the Point itself, we might leave both the contending Parties to fight it out, were it not for the Consequences which are applied to the human Soul. We have just now seen how groundless their Opinion is who deny Brutes to have an *immaterial Principle*: And if we would examine Appearances fairly, we could not find justifiable Arguments to conclude them rational Beings. It is plain the human Soul has a superior Power to that of Brutes; and if we should call that Power (whatever it be) *Reason*, the Controversy would be at an end.

M. This makes short Work; and sure I am that Man would be reckoned irrational, and unfit for the Conversation of his Species, who had not more Reason than the most perfect Brutes; than the *Dog*, the *Ape*, or the *Monkey*, which you reckoned to come nearest to the Confines of Reason.

P. The Observation is extremely just; and from thence it must appear an affected Partiality to suppose, that the *same Talents* should make a Man *brutish*, and a Brute *rational*. It is even contradictory to itself; for while it would bring down Man to the level of Brutes, it supposes that more is expected from him as a rational Being: And why should more be expected from him as a rational Being, but on the Supposition that Brutes are without Reason?

M. This is a plain Inconsistency.

P. However,

P. However, that we may search into the Foundation of their Mistake, please to observe with me, that Reason is a *self-improving* Power or Faculty of the Soul, by which Man is capable of great Advancement: And when he neglects to improve his Nature, he becomes indeed brutish with respect to the rest of his Species. But still this shews the Dignity of Reason above the Endowments of Brutes, which, rightly cultivated, so eminently advances the human Nature; and it is but poor Sophistry to run the Comparison in this studied Inequality. It is said, *Man differs more from Man, than Man from Beast.* Let it be so; let the Observation be as just as they please: The more true it is, the more it makes against themselves; for it allows that *Reason improved* is doubly elevated above the brute Nature.

M. This seems very plain; and the only fair Method in this Case would be, I think, to set the most perfect of the brute Species, in Comparison with the most perfect of the human; which would shew the Difference of the specifick Faculties in a true Light.

P. That would be to give up the Question at once. We can hardly imagine the Height to which human Reason has arrived in some Men; in a *Socrates*, a *Plato*, an *Archimedes*, a *Newton.*

M. Pray let me interrupt you, to ask, Who this last Man was? I have often heard him named, but never without Admiration.

P. He was the Glory, *Matho*, not only of

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his Nation, and of the Age he lived in, but the Ornament of the Species itself; whose wonderful Discoveries have advanced true Philosophy more, and taught us better to admire the Power and Wisdom of the Creator in the Works of Nature, than those of all the Philosophers that went before him, or, I'm afraid, will come after him. But for me to enter more particularly on his Character, would be doing myself Honour, but that incomparable Person none.——To return, if we consider on the one Side the amazing Improvements the rational Nature is capable of; and on the other, that the Nature of the most perfect Species of Brutes is strictly confined to a *certain Limit*, beyond which no Art or Industry of Man can raise them; it seems to point out to us, that the specifick Perfections differ not only in *Degree*, or more and less of the same Faculty, but in *Kind*; or that they are Powers of different Sorts.

M. It is strange enough, that all of the same Species of Brutes should keep so constantly to the same Train of Action; or if they be rational, that they discover no new Improvements, nor rise some of them above others, as we see it is among Men: And it is but a bad Sign, that they can neither improve by their own Industry, nor by the Assistance of Mankind.——

P. In the next Place let me observe to you, That Man may not only not improve his Reason, but pervert this improved Faculty to vicious

ous Purposes; and then he becomes a *more terrible Monster*, indeed, than any in the Deserts of *Africa:* And that this Degeneracy is not observable among Brutes shews only a Nature nearer to mechanical, and more confined.

M. I see the Force of the Consequence; the less Power a Creature has to act, the more uniform and regular its Actions must be.

P. Yet this affords those, who willingly mistake, a large Field to decry the rational Nature, and exalt the Brutes as the more perfect Beings. It it a true Observation, *That the Corruption of the best Things becomes the most hurtful:* But it can be no good Argument to infer from this, that therefore the best Things are the worst; since the Truth of the Observation depends on their being naturally preferable. *Freedom*, or a Power of *Self-determination*, is a high Privilege, without which there could be no Virtue in the best Actions, nor Improvement of our Nature in any Respect.

M. It is so; for if I am compelled to do a laudable Action, I justly lose the Merit of it, as it proceeds not from a right Disposition of Mind. And if a Creature hath but one Way of acting, the Action can neither be reckoned virtuous nor vicious.

P. That is what I was saying: There can be no Merit in Brutes not degenerating, or in their steadily pursuing one Train of Action, from which it was not in their Power to deviate.

M. And

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M. And so on the contrary, when a Brute Creature does a hurtful Action, it is not reckoned criminal or guilty; though a Man for the same Action would be punished, perhaps with the Loss of Life.

P. It is justly observed: In such Cases the common Sense of Mankind construes them not to be rational, but merely sensitive Creatures. And it is remarkable here, that a *Madman* is not reckoned accountable for his Actions, on this very Account; namely, because he is without the Use of Reason. Which seems to be a plain Confession, that Brutes are not rational or moral Agents: For if an accidental or temporal Incapacity deprives a Being of that Denomination, a constant and natural Incapacity ought much more to do so.——

M. You infer, therefore, the Superiority of the human above the brute Nature, as well from the *Corruption*, as from the *Improvableness* of it?

P. Doth it not appear so to you?

M. I own I am satisfied that this Equality among Brutes, and their not degenerating, is not owing to a right Use, but an utter Want of Power in the Brute Soul.

P. We ought then to blame the Man, who might have made a better Use of his Reason, and not find Fault with the Power which he abuses: Whereas we justify the Man, by laying the Blame upon the Power; that is, in reality, upon the Deity who bestowed it. In short,

short, there is a Complication of false Reasoning in this Case: We suppose, and admit, that the necessary Nature in Brutes is a moral Perfection in them; then we condemn the moral Corruption and Degeneracy of Man, as a physical Imperfection in his Nature and Constitution: And from this double Fallacy, we exalt the brute Nature, to the Disparagement of Reason.

LXXXI. *M.* I was pretty well convinced in my own Mind before, that Brutes are not rational Creatures, and am farther confirmed in my Opinion from these two Considerations you have pointed out, *viz.* That their Natures cannot be improved to any rational Purpose, and that they are not liable to the Degeneracy of Mankind: But what shall we say to many particular Instances, which are really surprizing, and are brought to shew that they reason in *some Cases?*

P. Those very Instances, *Matho*, render that Side of the Question extremely improbable. Why else should they argue from a few, ill-attested Particulars, which do not hold when put to the Trial? The Appearances from which we might with Certainty conclude, that brute Beasts are rational, should be universal, and liable to no Exception. If Brutes reasoned in *some Cases*, what should hinder them from Reasoning in others? And after all, What is it that makes those Instances surprizing, but because little is expected from them?

If

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If they were thought rational, the Appearances alledged would be looked upon as shamefully trifling, and from the Purpose: Nay, so silly are they, that they would then be brought as Instances of their Stupidity.

M. I am afraid you will cut off the Objections I had to offer, by these previous Considerations; the Reasonableness of which notwithstanding I cannot help owning.

P. By no Means: Propose your Objections.

M. What do you think of *Parrots*, *Magpies*, *Starlings*, and other Birds, which are capable of being taught human Language?

P. You yourself must certainly perceive, that this Instance is nothing at all to the Purpose. The *Gold-finch* also imitates the *Lowing* of a Bull, or the *Neighing* of a Horse, as *Pliny* observes: A Parrot imitates the Barking of a Dog, or, indeed, any Noise. This is mere Imitation of Sound. They imitate also articulate Sound, but without understanding the Sense. When Parrots learn to pronounce the Words *Whore*, or *Cuckold*, they cannot have the very complex Ideas which these Words excite in us. Children themselves learn Language at first in a Manner perfectly mechanical: There is no Connexion either natural or rational, between the Word and the Thing signified. And when a Bird learns to imitate the Sound, I cannot see how the Knowledge of the Thing signified can be communicated to it.

M. Some

M. Some Birds learn a Tune very distinctly; which shews that they have both Memory, and an Ear.

P. They imitate a Tune pretty distinctly for such Creatures: But an Ear is a Thing merely mechanical, even in *Man*, and no Effect of Reason at all. If you hear a Tune often sung or played, some Parts of it will return upon you afterward, without your Endeavour to recover it; and in Time the Whole of it will return upon you, and stick with you, in the same mechanical Manner. When this is so in us, it cannot be otherways in them. We endeavour to hit the Note purely in this mechanical Way, and not by Memory, or Judgment: And when they endeavour to hit the Note, it cannot be, I suppose, in a more perfect Manner.

M. I begin to suspect, indeed, that a *good Ear* is a Thing purely mechanical; and that he who has a better Ear, has not always either a better Memory, or more Judgment than another.

P. We might here observe, *Matho*, that the whole Effect of Musick upon Man himself is a Thing entirely mechanical, and has nothing to do with Reason: It is thus that several Sorts of Musick excite different Passions in us; one Air makes us languishing and sad, and another brisk and gay. And the Learned are of Opinion, that nothing is harder to be accounted for, than these various and violent Effects. What Reason can be given, why a

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certain Compoſition of Sound ſhould put *one Man* in a Rage, without affecting *another* any Way? Now no Body will deny, that theſe Animals may have any mechanical Affection in common with Man; for that has no Sort of Affinity with Reaſon: And yet it would be a wide Step in Argument to infer from this, that the ſame Tune has the ſame Effect upon the Bird that learns to imitate the Sound, that it has upon you or me; ſince it is poſſible that we may be very differently affected by it. In ſhort, ſince they imitate indifferently whatever Tune they hear, without Preference, I ſcarce think they underſtand the Harmony, or Fineneſs of the Compoſition.

M. Since this imitating Faculty has no Choice, they do not ſeem to perceive the Harmony at all, unleſs we ſhould ſuppoſe that they perceive Harmony in the Lowing of a Bull, or Barking of a Dog. We ought, I think, to reaſon with more Caution and Exactneſs in ſuch Caſes, than generally we do.—— But certainly, ſome Creatures are taught to perform ſtrange Tricks.

P. They are ſo: But the mechanical Methods which are taken to teach them ſhew, that they deal with ſenſitive Animals, and not with rational Beings. Upon a *Word*, or a *Sign*, the repeated good or bad Treatment is brought in View; and thus at laſt the *Sign* and the *Trick* become mechanically joined. This is extremely poor for a rational Creature! Nor can it be ſaid that this is for want of underſtanding

derstanding our Language: People that are born both deaf and dumb want Language as much as the Brutes; and yet act very consistently, and shew a surprising Ingenuity in learning many Things. The fifth Conference.

M. This I did not reflect upon before, and I believe I must give up the Cause. Brutes certainly have an Advantage over those Persons who neither hear nor understand Language: So that though Language be extremely proper and helpful to rational Creatures, I see it is not that which makes us rational; nor therefore doth the Want of it hinder Brutes from being such. The Imperfection lies deeper.——But I have heard of an *Ape* which played at Chess.

P. These are *common-place Stories*, *Matho*; we ought to proceed as cautiously here, as we do in experimental Philosophy. People must be satisfied that the Experiment holds; they will see it tried themselves, and weigh all Circumstances, before they draw any Conclusion from it. I could tell you many such Stories: But it is Time to leave the Argument when it dwindles into Fable.

M. I proposed the Story in Joke only; though those Stories are sometimes more than Common-place ones, they grow very particular, and People are affronted, if you pretend to doubt what they have been Eye-witnesses to, or had from good Hands.

P. Then it is not good Manners to dispute the Point; though it would be too much

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Complaiſance to allow that a Story of this Kind decides the Queſtion.

M. What you ſaid at the Beginning ſeems extremely reaſonable. The Appearances ought to be univerſal, and liable to no Exception, from which we could conclude with Certainty, that Brutes are rational. To ſay they reaſon at *ſome Times*, appears equal to ſaying, they reaſon not at all. I have often thought on hearing thoſe Stories in Company, that the perfecteſt Brutes do a thouſand Actions which ſhew they are void of Reaſon, for one that could be any Way conſtrued to be the effect of Ratiocination: So that in referring to Appearances, the moſt perfect of them muſt be reckoned a thouſand Times more abſurd than rational. This confounds all; for why ſhould their Reaſon come and go, by Fits? or not anſwer them on all Exigencies alike?

P. You are certainly in the Right: Reaſon is an univerſal Faculty, and applicable in all Caſes where the Difficulty is but equal: Even where it is greater, Reaſon ſuggeſts that they ſhould at leaſt doubt and deliberate. And when we obſerve all Species act with amazing Juſtneſs and Sagacity, in Caſes that concern the *Preſervation of the Individual*, or the *Propagation of the Species*; and yet in other eaſier Caſes behave with incorrigible Abſurdity; we may fairly conclude that they are void of Reaſon, and act from another Principle in *theſe two Caſes.*

LXXXII. *M.* From

LXXXII. *M.* From what other Principle? Or how shall we account for the Wonders they steadily and constantly perform in these Cases? For there are no Stories here; but every Man may be satisfied from his own Observation. The sixth Conference.

P. What Creatures are they which perform the greatest and most constant Wonders?

M. Why, the very least Animals do that which is most surprizing. The *Bee* is a pregnant Instance of inimitable Art; no Body needs indulge Fancy here, or tell a singular Instance which happened at such a Time, or in such a Place; every Thing is miraculous. The *Spider*, the *Ant*, the *Silk-worm*, and all those *Insects*, which pass through two or three States of Existence, raise our Admiration. *These last* act as if they had a full and comprehensive View of all the Transformations they were to undergo, and knew what Creatures were to rise from the Spoils of their Bodies, which they so carefully entomb for that Purpose. In their last State, they reposite their Eggs for another Circulation of Animals, as if they understood the Nature of Plants, and saw through the whole Process of the future Vegetation.

P. You owned, when we were speaking on this Subject before, that these little Animals wrought consistently in this mysterious Process, without knowing what they did.

M. The same Reasons shew me still that they work blindly, and yet consistently. I rest satisfied, that the Bee knows nothing of Geometry,

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Geometry, though the Cells ſhe builds are noble Inſtances of the Knowledge of that Science: Nor do the Birds of Paſſage keep an Almanack, though they rendezvous from all Parts of the Country on a certain Day; nor have they any Chart of the Country they are going to, or Compaſs to ſteer their Courſe by. Now it is this Paradox, or Myſtery (ſhall I call it?) of *Working artfully without Knowledge*, which I would have you unfold.——

P. Before we come to that, pray take Notice, That thoſe Creatures which perform the greateſt Wonders are certainly not endued with Reaſon. This rightly attended to takes off the whole Probability from their Side of the Queſtion, who would have the inferior Creatures rational; ſince the Things which require Reaſon and Knowledge moſt in them are performed by them without either. For if we are certain that theſe perform what is moſt difficult, from another Principle it would be humorſom and fooliſh to contend, that what is leſs difficult could not be done without the rational Powers of the human Soul.

M. I perceive, indeed, from what you obſerve, the Weakneſs of that whole Pretence. The *Bee*, not to mention her Work, ſeems to act more wonderfully in travelling out ſome Miles to the Heath to gather her Honey, and returning regularly to her own Home again, than the *Spaniel*, does in caſting round the Field to find out the Scent of the Fowl: And to contend that the Dog could not do this without reaſoning

reasoning in his own Mind, while the Insect does more, seems really no more than Humour.——But pray inform me, on what Principle do these little Creatures act? The sixth Conference.

P. Before I can do this you must tell me, Who teaches or instructs the *Young* of larger Animals, the *Lamb*, the *Calf*, the *Puppy*, *&c.* to suck their Dams? This is a common Instance, and without Ambiguity. They never saw an Example of this to copy after. Who informed them that a certain Liquor was proper Food for them? That this Liquor was to be found in the Body of their Dams? Or how to apply for it? Who instructed them in the Art of Sucking, the Principle of which was not known to Philosophers till late? Yet they go readily about this Work the first Thing they do.

M. Nature instructs them in all this.

P. Very well! Nature instructs all these lesser Creatures then, of which we were speaking, to perform all these Miracles of Art, which you so much admire.

M. But I don't know,—this does not satisfy me.

P. You have as much Reason to be satisfied with my Answer, as I have to be satisfied with yours.——What do you mean by *Nature?*—

M. To deal plainly with you, I do not very well know; but this is the Account I have often heard given.

P. Does this Account satisfy you?

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M. When I begin to examine it more narrowly, I find it is nothing but a *Word*, which shifts off the Consideration of the Point: And the Instance is so common, we never think it worth while to reflect upon it.

P. Consider it again, and tell me, Whether any Instance which is brought to shew that Brutes reason, be more wonderful than this very first Action of theirs?

M. It is both more wonderful and better attested than any Instance I have heard alledged.——

P. Come, tell me, Who teaches the *Young* of all Animals, without Exception, first to make Use of their Limbs, and move their Bodies? As we observed before, this is a Secret to all the Philosophers on Earth, how spontaneous Motion is performed. And how can every Brute, every Creature, so readily perform an Action, the Nature and Reason of which is such a Mystery! Who guides them in this Work?

M. I saw before, that both Men and Brutes are ignorant how spontaneous Motion is effected, but did not attend to any Difficulty in it.

P. There is the same Difficulty here, as when a little Insect works blindly, and yet consistently: For it can never be shewed that spontaneous Motion is performed by Reason, nor by Habit either, in the first Instance. Consider how complicated a Machine the Body is; the Motion of every part requires a different

different Touch: And yet not only the Lamb, or the Calf, but the *little Chick*, hardly excluded the Shell, touches every Part of the Mechanism *artfully*, and *without Hesitation*. To see a little Bird run nimbly from you, with some Part of the Shell still sticking to it, is, if you reflect on it seriously, a more astonishing Instance, than if you saw a Person play skilfully on a Spinet, the first Time he had ever seen one.

M. You give me a View of the whole Wonder in this. It is foolish, I perceive, to be peremptory, that the Actions of Brutes are performed by their own Reason; when we do not know on what Principle such a common Action as spontaneous Motion is at first performed by ourselves. And as to a *Habit*, the first Practice in other Creatures seems equal to the Perfection of a Habit. No Body, I believe, thinks there is any Difficulty in this, that a Lamb newly yeaned should rise from the Ground, and walk about its Mother; though it sees its Dam walk; that is all internal and hidden Work to it.——

P. Once more, *Matho*, for I must ply you close with Questions; tell me who guides the *Peach-tree* to produce a *Peach*, rather than a *Pear*, or an *Apple*, or a *Cherry*, or a *Goose-berry*, or any other Kind of Fruit? For you remember that different Sorts of Trees may be grafted on the same Stock; and so the different Sorts of Fruits have but one common Matter to be wrought from:

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And that the Pulp or Fleſh of the Peach, the Skin, the Kernel, and even the Stone itſelf, were but a few Weeks before in the Form of Sap: And laſtly, Seeds, you know, are not like *Moulds*, to direct the unſteady Hand of the Workman, but are themſelves originally formed without Mould or Pattern.

LXXXIII. *M.* Right, *Philon!* — Give me Time to recollect a little.

P. Conſider the Point at your Leiſure.——

M. This ſhews me ſeveral Things at once. There can be no Miſtake here. I ſee by whoſe Art this muſt be done, where there is no living Creature to aſſiſt in the Effect. The conſtant Direction of the Deity is neceſſary in this Caſe; and it is no leſs neceſſary in the Formation of all animal Bodies, than of Vegetables: And farther, when theſe little Creatures have no Faculties to contrive, nor Knowledge to comprehend the myſterious Proceſs they are employed in, it is ſtill equally neceſſary, and equally plain, that they muſt be guided by the ſame Wiſdom, which conſtantly directs the Formation of their Bodies. The Tranſition is natural and eaſy. God is not leſs careful of *living Beings*, than of *vegetable Things*. I ſee it now! This is that *remarkable Connexion*, which you hinted before to be between the vegetable and animal Kingdoms, gently guiding our Mind in the Continuation of the *Scale*: The Steps are ſoft, indeed, and beautiful in this

this View! The *lower Animals* were not immediately to be abandoned to the Guidance of their own Powers. The Transition from Plants, *(mere vegetating Matter)* to free and self-directed living Beings, had been violent, and indeed forced. O! I am charmed with the Thought! How unnatural would the contrary Supposition appear, to a Mind not misled by Prejudices! How impossible, that such little Insects, such microscopical Animalcules, could have provided for their own Lives, for the Continuation of the Species, had not the Wisdom of the *Creator* supplied their Want of Power and Knowledge! This is that other *Limit* you spoke of, which bounds sensitive Perfection on the one Side, as Reason does on the other.

P. This is that Principle of INSTINCT, *Matho*, which we talk so much about, without being aware how *real* it is, or how widely it extends among the Tribes of Animals, not excepting Man himself.

M. I was going to observe how indulgent and kind the Creator is: For from the Instance of *sucking* and *spontaneous Motion* I see that, were it not for his supplying the Want of Knowledge by his early Direction, no Species of Animals, not even Man, could get over the first Difficulties of Life, but must instantly give up their new gotten Breath, under an Inability and Ignorance, what to do to preserve it.

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P. The Change in Truth, as you obſerved juſt now in the other Caſe, would be too ſudden and violent, to abandon an Animal newly excluded the Womb, which was but the Moment before in the Circumſtances of mere Vegetation and *Plant-Exiſtence*; to abandon it, I ſay, all at once, to its own Care and Proviſion, with no more Experience and Power than it brought from the dark Cell of the Womb with it.

M. From this I ſee that what we call *Inſtinct* in Animals is the conſtant and immediate Direction of them, by the ſame Divine Power and Wiſdom, which brings forward and guides every Plant of the Field, to its ſpecifick Perfection. It is this pleaſing Conſideration which we conceal from ourſelves, by aſcribing all theſe Miracles of Power and Goodneſs to *Nature*.

P. Nature, *Matho*, is the Deity of the *Atheiſt*, the Knowledge of the *Ignorant*, and the Refuge of a *ſlothful Mind*, in which all Abſurdities are conſiſtent. Nature, as an *univerſal ſurd Cauſe*, ſuperſedes farther Enquiry; and as a *mere Non-entity*, it requires of us neither Fear nor Reverence.

M. I ſhall be upon my Guard for the future, to have a conſiſtent Meaning in View, when I uſe the Word: But it is a Misfortune that the common Uſe of Language has almoſt conſecrated a *Term* that miſguides us; whereas *The Author of Nature* is a Manner of Expreſſion, which carries with it Light and Information to the Mind.

LXXXIV. *P.* To return, these lower Animals are constantly guided by this Principle of *Instinct*, which never forsakes them: This we may conclude from considering that Experience makes them not more perfect in their *Buildings*, *Manufactures*, *Provisions*, than they were at first.

M. And from this also I conceive, that many Species of them live but for one Season, and do the same Works but once.

P. And even in those, *Matho*, which survive for several Years, we never find any Improvement. Not only in the Works of the *Bee* or *Spider* we perceive no Difference between the Performance of the young and the old; but we find the same Equality of Architecture in the Nests of *Birds*, whether they have built for the first Time, or oftener. Which shews us that Experience is of no Use to them, and that they still act under the Direction of the first Principle. —In rising through the Scale of Animals, we may observe that they begin gradually to act in many Cases by the Direction of Sense; but wherever that would fail to guide them, *Instinct* comes in to their Relief. Hence it is that they know their *Enemies* at any Time, though they have never seen them before; and their *natural Weapons* for Defence, though they never had Occasion to use them before. The Females through all the Species are as *perfect Mothers*, and as knowing in rearing

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their young for the firſt Time, as ever after. The cowardly then become reſolute, and the ſimple full of Stratagem: Afterward they ſink into their natural Stupidity again. Whence this *temporary* Courage and Subtlety? This ſhews that *Inſtinct* never forſakes the moſt perfect of the brute Species, when the Point concerns *Self-Defence*, or the *Propagation of the Kind.* ——It hath been excellently obſerved on this Head, that Reaſon is full of Variety, and therefore is ſtill ſupplanting one Contrivance with another. Hence the Diverſity of Arts, Cuſtoms, Manners, and of Language itſelf, in different Countries, and ſucceſſive Ages. It is not ſo among the moſt perfect Species of Brutes; they have the ſame unvaried Talents, Sagacity, and ſpecifick Endowments, in all Countries, and through all Ages. This at once ſhews the *Limitation* of their Nature (which we ſpoke of before) and that theſe Arts and permanent Policies are not of their own deviſing. Take any of theſe Animals from the *Dam* when young, and bring it up ſeparately from the reſt of its Species; notwithſtanding this, you will ſee it grow up as perfect in all the Arts and Behaviour of that Species, as if it had been bred among them. On the other Hand, imagine that ſome of thoſe Stories we have heard related were true; and that one of our Species was ſuckled, and brought up by the wild Beaſts in the Woods; and then conſider whether ſuch a Crea-

Creature would naturally fall into the Manners and Behaviour of Mankind.

M. It is not to be supposed; such a Creature would be a *mute Monster*, agreeing with no Species of Animals in the Creation. I am quite satisfied of the Force of *Improvement* upon human Nature, and that it has no Force at all upon the Brutes, which are made perfect at one Stroke: Hence I perceive that the Faculties by which Men, and inferior Animals, become perfect in their several Species, differ not only in *Degree*, but in *Kind*, as you observed. I could ask you many Questions concerning the Origin of Language, which I see is not natural to Mankind, though most other Creatures have some natural Cry, which I suppose has been peculiar to the Species from the Beginning of the World: But, without interrupting you, shall observe, that I have often known a *Puppy* grow up in a Family, where it saw none of its own Kind, and yet become as perfect in the Arts and Genius of that Species, as if it had been educated in the Kennel.

P. The brute Mind is certainly less active than the human; the great Spring of Action in them is their being stimulated by some bodily Appetite: Now that a less active Being should so readily jump into all the Arts and Manners peculiar to their several Tribes, and be utterly incapable of any other; and that Man, with more Activity of Soul, should require so much Time to acquire the Perfections of

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of his Nature, concludes ſomething more than Mankind will allow themſelves to reflect upon.

M. You have brought me entirely over to your Side. As this Argument is equally applicable to the moſt perfect, as well as the leaſt perfect Animals, it convinces me that theſe *unſtudied Arts*, theſe *extemporary Endowments*, for which we ſo much admire them, are none of their own Acquiſition, as Men's are, but come from a higher Origin.

P. It ſeems to me equally to cut off the Pretenſions of the higheſt and loweſt Species to the Power of Reaſoning. Senſitive Perfection, indeed, riſes by various Degrees, which always brings their Actions nearer an Imitation of ours: Their Senſes aid each other in a manner we can never be Judges of. No Man would allow that Colours might be diſtinguiſhed by the Touch, if ſome Inſtances did not ſhew it poſſible. From this Acuteneſs of Senſe it is, that many Animals prognoſticate the Changes of Weather, which we cannot foreſee. You remember the Paſſage

—*Nunquam imprudentibus imber*—

A great Source of our Miſtakes about Brutes ſeems to be, that when we conſider ſome of their Actions, and the Operations of our own Minds in like Circumſtances, without farther Examination of their Natures, or taking

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in the whole Tenor of their Actions, we ascribe to them, from these particular, equivocal Appearances, all the Workings of the human Mind.

M. I am verily perswaded this is often the Case. We early contract a Liking to some particular Animal, or Species, which makes us partial in their Favour; and then we set up for *rational Brutes* all our Lives after, without examining the Point farther.

P. This is the first Notion we naturally fall in with, and it rarely comes under such a severe Review, as most of our other early Prejudices. But it is Time to leave a Subject, which you will hear discussed in every Company, according to People's Humour or Inclination.

LXXXV. *M.* Pray, before we leave it, tell me, what that Power of the Soul is, in which Reason chiefly consists, and which the Brutes have not?

P. We have not Time to go to the Bottom of that Subject: However, I shall tell you in general what my Thoughts are about it. Brutes have certainly the same Power of spontaneous Motion, as we Men have; and some of them a more early and absolute Command in moving their Bodies: Most Species also have their Senses far more acute than Man, as was observed just now. And it was but reasonable, that Creatures, which want a higher Power of the Soul, should have

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have the ſenſitive Nature in greater Perfection. If then they had the ſame Command over the Perceptions of the Mind that Man has, they would be, I think, equally rational. For if we conſider your Inſtance of *a Puppy brought up in a Family*, without ſeeing any of its own Species, it has certainly the ſame original Perceptions, as the Infant with whom it lives familiarly: And if it could make the ſame Uſe of the ſame original Ideas, or work the ſame Way with them, it would improve equally, and at length become as perfect a *Reaſoner* as the Child.

M. I perceive the Truth of all this as you go along.

P. Then it could be ſhewed, I preſume, with Exactneſs and Preciſion of Argument, That the Power of calling back to View, and detaining under Conſideration, the paſt Perceptions of the Mind, is that alone from which all the rational Operations of the human Soul are derived.

M. Do you think that ſuch a Variety of Operations can ſpring from ſo ſimple a Power?

M. This appears to me a right Symptom that the Thing is really ſo. Nature (to ſpeak in the common way) that is, the Wiſdom of the Deity, is frugal in the Means, and fertile in Effects. By the Help of this Power alone, we compare our original Ideas, compound them, divide them, and abſtract from them; forming at firſt with Difficulty general Notions, and from theſe again others ſtill more

more abstract; and, in a word, perform all those Operations, which belong to Ratiocination. It is but the same Power variously exerted, to which Men have given the Names of various Operations. For in seeing the Agreement or Disagreement of our Ideas, or their several Relations to each other, after they are carefully formed, and clearly perceived, we are as necessary, or passive, as in seeing the Agreement or Diversity of two Objects when presented to the Eye. And you may observe in all the Arts that Men learn, the various Application of the same Power, begets a great Variety of Appearances in the Practice. The sixth Conference.

M. I begin almost to be persuaded of this, when I consider that the Power only of moving the Hand is that by which all mechanical Arts are acquired and practised; though this Power receives various Turns, as the Hand is habituated to different Tools or Instruments: And if the Hand is any way disabled, the Exercise of the Art is lost.

P. No Simile hits in all Respects, *Matho*; but yours is so far just, that if we suppose the Power of calling back past Perceptions into the Mind entirely lost; though the Man should still be a *principient Being*, he could no more reason, or reflect on what did not immediately strike his Eye, than he could read a Book in the Dark, or see Objects through a Stone Wall.

M. Thus far is very plain.

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P. Consider also this Circumstance. If we had not the Power of calling back our past Perceptions at Pleasure; but if, instead of that, they were obtruded upon us, or brought into our View at the Discretion of some other Being, (as often happens in our Dreams) we could never reason consistently, but should live under one continued Deception.

M. I believe I must come into your Notion, that this Power is really the Foundation of Reasoning; since if it be taken away, or restored, the Faculty of Reasoning is at the same Time lost, or recovered; and in Proportion as it is disturbed, our Reasoning becomes inconsistent; as is often the Case in Sleep, and Disorders of the Head.

P. If then we consider in the last Place, that the Mind of Brutes is calm and still, unless when some Call from Sense prompts them to Action, it seems to follow, that this Power of calling back their past Perceptions to View, is the Power they are not endued with; in Consequence of which they have nothing to guide them, when taken out of the Train of *Sense* and *Instinct*, whence they must act absurdly in all such Cases.

M. All this is extremely reasonable; but there is still one Thing occurs to me, which looks like an Objection.

P. What is it?

M. Brutes sometimes seem to act from the same Principle, and in the same Manner, as rational Creatures do: Thus an Animal be-

reaved of its Young, or of its Mate, is hurried on with Rage, or sunk in Grief. The sixth Conference.

P. The inferior Creatures, *Matho*, are tortured with more violent Passions than Men; which is by no Means a Mark of their being rational, as some imagine, but rather of their being irrational. Passion is purely an *animal Affection*, and maintained in the Mind, not by a Command over the past Perceptions, but by a Want of Command over them; or by the same Perception remaining still in View. The Object of *Grief*, *Jealousy*, or *Revenge*, sits close on the brute Mind; and by that alone it is hurried on, without Relief from the Power of calling in other Ideas to be at the same Time considered. It is thus they fight and tear each other, with irreconcileable Rage, and often without any apparent Provocation. We may know something of this from our own Experience: The Expressions, *Ira furor brevis est*,——*Impedit ira animum*——have a more philosophical Meaning than we are aware of. Could we examine our past Perceptions coolly while in Passion, as at other Times, we should rarely be under these brutal Affections. So that I would take the Liberty to correct what you call an Objection, and, instead of saying that Brutes act from the same Principle, and in the same Manner as rational Creatures; say, rational Creatures often act from the same Principle, and in the same Manner as brute Beasts.

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M. I find what I took for an Objection, rather confirms what you advanced.——With respect to that constant *Stillness* and *Silence* which you say reigns in the brute Mind, except when the Calls from Sense solicit it, I have observed, I think, that some Species of Brutes, those particularly that feed on Vegetables, sleep less than Man: Their whole Business seems to be Food and Rest. Now I have often wondered what could be the Object of their Thoughts, while they lie for several Hours together on the Ground: And I begin to fancy, if their Minds were busy all the while, their Bodies would not have so much Ease; that they would be put on some Action, or give some Indication of what passed then in their Thoughts.

P. This Calmness and Inactivity of the brute Mind seems to be every Way wisely ordered: For to what Purpose should Creatures have their Minds occupied, whose Nature requires nothing, which they are not in Possession of? And then, were they to reflect ever so little, how terrible would they be to Man! It must be constant War, without Quarter on either Side. Did they know their own Advantage, who durst appear in the Fields, or perhaps be safe in Houses? The *laborious Ox*, and the *serviceable Horse*, would be our most dreadful Enemies. The most tractable Creatures would rebel, and few are so weak that might not annoy us. It would make all the Odds in the World to the Life of Man, to want

want their Assistance as Brutes, and to feel their Enmity as rational Creatures. Consider the Consequences of this at your Leisure, with respect to our Carriages, Travelling, Tillage. They could live easily without us; especially when furnished with rational Faculties. Men will needs have Brutes to be rational, without considering what a Misery it would be to us, if they were. If they reflected but ever so little, they would never bear the unequal Conditions they must then labour under. Would they submit their Back to the Blows, and their Throats to the Knife? What Goodness is it then, that Creatures so much stronger than Man should nevertheless be subjected to the superior Power of his Mind!

LXXXVI. *M.* These Reflections are quite new to me: I see with Surprize the terrible Disorder that must ensue in the Animal World, on the Supposition that Brutes were rational. I have only one more Question to trouble you with on this Head.

P. I am glad to hear that; pray propose it.

M. Does the advantageous Structure of the human Body contribute nothing to the Perfection of the rational Soul? Or would not a brute Soul be rational if in a human Body.

P. You observed frequently and justly, at our last Meeting, that a mere Figure, or mere Order of Parts, can teach a Creature nothing. Were you or I turned into the Figure of a Swallow, as the Poets say *Progne* was, we

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should know no more of building a Swallow's Nest, (which, though clumsy in Appearance, is justly admired as a notable Piece of Architecture) than if we were turned to the Shape of a four-footed Beast. We could do nothing without being guided by the same Principle of Instinct, as well as having the same Figure. The Lark, and several other small Birds, seem as much cut out for such a Piece of Work, as the Swallow: Yet every one of these have a different Art of Building, and quite different Instincts. Animals differ more in their Instincts and Genius, than in the Shape and Figure of their Bodies: Consider a *Hare* and a *Rabbit*; or a *Rat* and a *Mole*; they have quite different Instincts, and scarce live in the same Element. Many such Instances might be given in Birds and Fishes. This could not be, if the various Structure of the Body endued Creatures with various Talents. Have you reflected on the Absurdity contained in your Question? *The Deity forms the Body, a System of dead Matter; and this System of dead Matter forms the Soul!* The Origin of this unaccountable Prejudice is, because the Creator hath so wonderfully adapted the Structure of the Body to the Capacities and Powers of the living Part. Hence we infer, that the Soul owes its Capacities and Powers to the Structure of the Body. Pray call to Mind again the Inertia of Matter: I thought there had been no Occasion for resuming the Consideration of that Subject.—The *Spider*, it is true, could not

not handle her delicate Threads so nicely, without her exquisite fine Fingers: But those Fingers do not teach her to dispose her Threads, or how to accomplish the Design of her Web. The Club-shape of the *Bee* is nevertheless excellently fitted to the forming her hexagonal Cell: But this Shape doth not shew her either the Property of that Figure, or how to observe the Proportion in Practice. The short strong Legs of the *Mole*, are skilfully designed for her Working under Ground; but they might for all that remain useless, unless she were prompted with the Art of employing them. And so in other Cases. The Parts of the Body, therefore, serve only as Instruments to answer the several Powers and Instincts of the immaterial Being: But surely they are neither the *Powers* that move themselves, nor do they teach the Art whereby they are employed. We saw before that the Power of the Deity must intervene to perform the mechanical Part of spontaneous Motion, and relieve the Soul: and as to the Method by which this is contrived, it remains an impenetrable Secret. After this let a sober Man suppose, if he can, that the different Structure of the Body makes one Creature rational, and endues another with Instinct.

M. Though all this be now very plain from what you said before, I should have been at a Loss in making the Application; and am pleased that I proposed my unskilful Question. As the brute Body could not give any Instinct to the human Soul; so contrarily, I see now

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that the human Body could not make the brute Soul rational.

P. Moſt certainly it could not. There is nothing ſo unphiloſophical, and abſurd, as thoſe idle Stories of Changes of Shapes, and Metamorphoſes, with which the Heads of Boys are ſtuffed. Were a brute Creature transformed into a human Shape, it would be nothing more than a *breathing* or *ſenſitive Log*, without ſo much as the Power of ſpontaneous Motion in ſuch a new Body. This firſt Step (as was obſerved) would require the Interpoſition of the Deity. And then conſider the human Soul itſelf, by what various Degrees of Improvement it arrives at the Perfection of its Nature. After that tell me, if you think a brute Soul could be converted into a rational Being, merely by ſhifting Habitations? ——It is certain, that the firſt of our Species were made rational, and endued with Knowledge, without their own Application; that is, by the immediate Power of the Deity. All the Philoſophers on Earth will never account for the Origination of Mankind otherwiſe. And in the ſame Manner alſo they were prompted with the firſt Uſe of Language. Now to imagine that a Frame of dead Matter ſhould have the ſame Effect, as the divine Power, is, to ſay no more, ſtrange Inatttention.

M. I am glad you have given me this Hint concerning the Origin of Language. Young People help to deceive themſelves by their own Credulity. When I read that Piſmires were

were metamorphosed into the *Myrmidons*, I imagined they spoke the Greek Language of Course: As if Language was a necessary Consequence of having a human Figure.

P. Leaving Fable, *Matho*, we may observe, if the Frame of the human Body could not give the Soul the Power of moving itself, without the immediate Help of the Deity, it could much less endue the Soul with the Power of Reasoning. The Body of Man, indeed, has a more curious Mechanism, a more complicated Apparatus, and particularly in the Brain, than the Body of any other Animal; as *Anatomists* have observed, and as was but just and necessary, to serve for more various Purposes: But all this Apparatus is only the Instrument for executing, not the Power that executes. A more complicated Machinery requires more Power to work, or employ it, than a simpler System; but can as little impart any Power, as unwrought Matter itself.

M. This I understand; and from this I conceive it will follow, that a Disorder of the Mechanism in the Body, would impede the Exercise of the Powers of the Soul: But the best Order could bestow no Power upon it.

P. It is directly so. You observed excellently well before, That a *Loom* could never teach one the Art of Weaving; though one who understood the Art of Weaving might employ it to that Purpose. And the Argument is the same wherever Matter or Mechanism is employed. And after all, pray reflect, *Ma-*

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tho, what absurd and inconsistent Suppositions those are, which we borrow from the *Poets*; *That a brute Soul should animate the human Body, or a rational Soul the Body of a Brute.* By whose Power could this be effected? If by the Creator's alone, why should we suppose him to act contrary to the Natures of Things by him established? Or why study to draw an Argument from his Power for equalling Beings, which the same Power has made different? This is taking an Argument from the wrong Side to suppose the Power of the Deity to counteract his Wisdom. Since the uniting of the Soul to the Body is his immediate Work, there can be no mis-joining of Souls to Bodies. We first suppose that *Chance* might have the Ordering of this Affair, and then enquire how Things would be, if disposed otherwise than the Deity has done: Which is notably foolish. It is as if we should ask, What kind of a Flower the *Tulip* would be, if it sprung from the Seed of a *Melon?* Or what Taste an *Onion* would have, if it grew on a *Fig-Tree?*

M. You have fully opened to me the whole Impertinence of my Question, and the Ignorance of such Suppositions. I hope I shall think more correctly with regard to these Matters for the future.

P. We ought to reflect with Pleasure, *Matho*, that the Power of the Creator is immediately concerned in the Natures of these irrational Creatures: This is doing Justice to them; and it assures us that he will not, cannot neglect rational Beings.

LXXXVII. *M.* After this short View of the Works of Nature, pray resume a little, before I leave you, a Subject you just touch'd upon some Time ago, concerning the Nature of the Deity, and the Necessity of his Existence. The sixth Conference.

P. I thought *Matho* had been a Man of his Word.

M. Come, *Philon*, you must not deny me: You don't use to do a good Office by Halves.

P. It is not an easy Thing to speak of the Deity abstractedly, and in his own Nature, which is so much above our Comprehension: It is both more intelligible, and more delightful to speak of him as the Cause of all other Things that exist. In those Effects we see his Perfections of Power, Knowledge, and Goodness, displayed to us in the most obvious Manner; and thence come to the Knowledge of him, as he is the Creator of all Things. This, as we observed before, is a comfortable Relation, between the Deity and us.

M. But pray shew me how the Necessity of the Deity's Existence appears?

P. Power and *Knowledge*, you know, are that only which is necessary in the Nature of Things; for this obvious Reason, because if Power and Knowledge did not necessarily exist, they could not be produced by a Cause without Power and Knowledge; that is, by

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an *ignorant* and *impotent Cauſe*. Which is the ſame as ſaying, if Power and Knowledge were not neceſſary, they muſt be abſolutely impoſſible and contradictory. Thus far you ſee?

M. Perfectly well.

P. Then, for the ſame Reaſon that Power and Knowldge are at all neceſſary, infinite Power and Knowledge are neceſſary: For Things of a contrary Nature could not limit them; or rather, there was nothing of a contrary Nature to limit them. Since Impotence and Ignorance are mere Negations.

M. Thus we find infinite Power and Knowledge neceſſary.

P. Next, it is the Nature of infinite Power and infinite Knowledge to be united, or to belong to the ſame Being. Things of a contrary Nature, or mere Negations, could not ſeparate them. Nothing could oppoſe infinite Power, or ſeparate Knowledge from it, except Impotence, or want of Power, which is no Cauſe: Nor any Thing ſeparate Power from infinite Knowledge, except Ignorance, which is nothing poſitive. And it is not the Nature of infinite Power to divide itſelf from Knowledge; nor of infinite Knowledge to divide itſelf from Power: The firſt would be then *infinite Fury*, and the ſecond *infinite Folly*.

M. Moſt certainly.

P. Then from a Plenitude of Power and Knowledge, you yourſelf infer'd the Neceſſity of *Goodneſs* and *Juſtice*: Becauſe a Being

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ing possessed of all Power and all Knowledge, could neither have *Malice* nor *Envy*; nor therefore be tyrannical, nor unjust; but rather infinitely Good, and infinitely Just. This is a necessary Result from boundless Power and Knowledge.

M. This too I remember very well.

P. Now, since it is the Nature of these four Perfections to belong to the same Being, and since there was nothing of a contrary Nature to separate them; or since their Nature is all that *was*, or *is necessary:* That they should be separated from each other, or divided among more Beings, is a Thought so much without Foundation, that when we form our Notions truly, and according to Reason, it will not be in our Power to conceive the Possibility of it. Hence the *Unity* of the *Deity* so little wants a Proof or Demonstration, that we must see it necessarily and intuitively, when we fall into the right Train of Thought.

M. You have resumed the Subject just in the very Manner I wanted to hear it: This will stick with me better, because it is a short connected Account.——From this I see that it is the most grievous Absurdity, and Contradiction to Nature, to suppose the *Non-existence* of the Deity. If the Deity did not exist, nothing at all could ever have existed. There must then have been an infinite and universal Non-existence, *an infinite, an eternal*, and *necessary Nothing!* What a monstrous

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strous Absurdity is this! *Being* and *Perfection* must then have been necessarily impossible! What poor Reasoners the Atheists are, who do not see the necessary Nature of *Power* and *Knowledge*, from this Alternative, That these must either be absolutely necessary, or utterly impossible in Nature!—An *infinite*, an *eternal*, a *necessary Nothing!* These are terrible Contradictions!—Infinite, eternal, and necessary, must belong to something positive. Hence I see that *Being* and *Perfection* must be *infinite* and *necessary*: Or this Necessity concludes for Plenitude and Infinity of Being and Perfection, as much as for Being and Perfection at all.

P. You have entered deep into the Thought, *Matho.*

M. This Subject was difficult to me the first Time we touched upon it: But now I am saying nothing, but what I have a clear and firm Notion of.

P. Allow me then to ask you a Question or two.

M. With all my Heart.

P. Does this Necessity hold, as well to Eternity, as from Eternity? For some People doubt of this.

M. It is a Necessity of Nature, which can never wear out, nor hath it Respect to Time. To suppose that this Necessity could ever cease, is to suppose the *Necessity* of Being and Perfection, a *Possibility* only of Being and Perfection! It is to suppose that Necessity of Existence

istence might at length become a Necessity of Non-existence! It is to suppose that *nothing* might some Time or other be possessed of the Properties of *infinite* and *necessary!* If *Nothing* may have this Reality of Nature, *Truth* is at an End, and *Reason* antiquated! Lastly, those People forget, that this is the Necessity of Infinity of Power and Knowledge. What could prevail against these! The sixth Conference.

P. You point rightly to the monstrous Consequences of a contrary Supposition. Tell me next, Doth the Existence of the Deity depend upon his own *Will*, or *Power?*

M. To suppose the Deity existed, because he willed it, or had Power to give himself Existence, is to suppose him once not to have existed, and at the same Time to have had a Will whereby he chose to exist, or Power to cause himself to exist. These are ill-coupled and inconsistent Notions in the Brain of Man. As was said before, to perform, or reconcile any Contradiction, is not the Object of real Power, or Knowledge; and least of all to perform or reconcile this shocking Repugnancy. To suppose the Perfections of the Deity to depend upon his Power, or Will, is only setting one Perfection of his Nature in Opposition to another, either ignorantly or perversely.

P. This is a notable Instance of Contradiction, which we may leave the *Scepticks* to doubt about: And since the Performance of any Contradiction supposes the Power of the Deity

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Deity to give his Knowledge the Lie, we may observe, as we go on, *how firm the Basis of human Knowledge is.* Let me only ask you farther, since the Existence and Nature of the Deity alone is necessary, whence have other Things their Nature and Existence?

M. There being no Source from which any Thing else can be derived, all other Things must be his Effects: Or they must have been created by his Power, and have derived their Natures (or the Properties of their Being) from his Knowledge. And now, *Philon*, I see that the Deity must be the *Creator of all Things*, even by this Method. For as I understood before, by considering the Nature of Matter, that it was the Effect of his Power; so I perceive now, by considering his Nature, that Matter, and all Things besides, (I mean *immaterial living Beings*) are the Effect of the same Power.

P. We may indeed come to the Knowledge of the same Truth, either by beginning with the *Effects*, and mounting to the *Cause*; or by beginning at the *Cause*, and descending to the *Effects*. Both Methods are good in Conjunction, and serve to illustrate each other: But this last Method does not convey such a practical Conviction to the Heart; and it requires a Mind perfectly subjected to the Determination of Reason: Though it may sometimes be necessary to silence a metaphysical *Adversary*, who may run up his Objections into abstract Speculations. For then, as was

observ-

observed before, we can thus shew, that the Reason for the Existence of the Deity does not depend on the Existence of the material World. The sixth Conference.

M. But with all Submission, I cannot help thinking, *Philon*, that the Mind of Man often runs into these abstract Speculations by itself, and without being forced upon them by Opposition. We naturally indulge such Thoughts at Times, and the Reveries of young Minds are nearly allied to the Researches of Philosophers. I have often thought with myself, what must have happened, if nothing had existed from Eternity? Or why all Things might not again cease to be? Let me throw out of Existence whatever I would, I found *Eternity* necessarily remaining, and *Space* too; but had not Compass of Thought enough to reflect on the Reason that shews *Power* and *Knowledge* the first Things necessary. Now in such Cases it is of Use to have some firm Principle to reason from, or return to, when one finds one's self lost in the Enquiry. And upon this Account, pardon me, if I think, that it is proper to enter a young Mind on the Consideration of the Necessity of Existence, as soon as it becomes liable to fall into these Reveries.

P. I dare not dispute your Experience, *Matho:* But since you think these Notions so easy to young Minds, pray make the Trial among your Companions, since you say you discourse our Subjects over again with them.

M. I

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M. I shall not fail to try the Experiment, and report the Success.——But

LXXXVIII. Something occurs here, which I cannot well reconcile to what has been said.

P. What is that?

M. If nothing besides the Deity himself be thus necessary and immutable, how is it that we find *Truth* equally necessary, and the same from Eternity to Eternity? No Power can change the Nature of Truth, or, as was observed just now, make a Contradiction true.

P. Nothing, *Matho*, except the Deity himself, or what belongs intimately to his Nature, can be necessary. And hence it is, namely, because the Nature of Truth is necessary and eternal, that an *eternal Intelligence*, or the *divine Intellect*, is discoverable by us in a very singular Manner, and wonderfully proper to the Nature of the Thing.

M. Pray shew me how that Discovery is made?

P. Eternal Truths have no Connexion with the Existence of created Things, and can neither be created nor perish; but being necessarily and unchangeably true, were always known in the *divine Intellect*, where they exist immutably, (if the Expression may be proper) which *Intellect* therefore they discover to us immediately.

M. As this is quite new to me, please to explain it more at large?

P. Have

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P. Have you never heard that in the *abstract Sciences*, new Truths and Properties of Things, such, to wit, as were not known to Mankind before, have been discovered?

M. Often; and those deservedly praised, by whose Industry those Truths were brought to Light: At the Head of whom, I suppose, from what you said, the *Great Newton* deserves to be placed.

P. You have Reason to say so,——But did those Authors make such Truths originally, or frame and mould them according to their Pleasure?

M. Surely they did not; for then the Truths could not have been said to be discovered, or found out, but Truths newly made or contrived. When any Thing is discovered, it must have been the same Thing before it was discovered, as after. When a Man discovers a *Mine* in his Ground, it would be absurd to say, *he contrived*, or *made the Mine*.

P. Besides, *Matho*, if it were possible to *coin*, or *stamp* new Truths, according to every Man's Fancy, what Work should we have? What Confusion, and Ruin of all Truth? You may imagine the Consequences of this yourself. Every Man would raise a System of Science, to support his Party, or advance his Interest; and another would confute it by contrary Truths, to maintain his Side of the Question. Where would this end among jarring Humours, and contrary Factions? Truth would fight against Truth, and nothing could be true.

M. Ah!

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M. Ah! speak no more of it; the Confusion would be inexpressible! Nothing is more necessary than *that Truth should be necessary, and unyielding*; that Men of honest Intentions may have a certain Standard to be directed by, and designing Men something to condemn themselves in their own Breasts.

P. If then the Nature of Truth be thus eternal and unchangeable, from what shall we derive it? Consider that Question first.—Then, Does not the Deity, think you, know all Truth?——Could his Knowledge be infinite if he did not?——Can there be any Knowledge in a created Intellect that he does not know?

M. That cannot be supposed, without an impious Absurdity.

P. Could he be beholden to any Thing else, do you think, for the Perfection of his Intellect? Or can Truth have a separate Nature, to and from which he is forced to apply and learn? We saw that his Knowledge is necessarily infinite. Can Truth then, eternal and necessary Truth, have a separate Nature of its own, independent of this necessary Infinity of Knowledge?——Where will you place this independent Nature of Truth?---In Emptiness! inert Matter! or a Negation of Perfection! For the Nature of the Deity comprehends, exhausts every Perfection; leaves out nothing, except Imperfection, Impotence, and Ignorance.

M. Do not multiply your Questions so fast. I see that the necessary Infinity of Knowledge, and

and the necessary unchangeable Nature of Truth must coincide. The fifth Conference.

P. Let a Man shew me two separate necessary Natures; one to be the Fountain of Truth, and the other the Origin of Knowledge abstracted from Truth.

M. You make the Contradiction monstrous; and have fully satisfied me of this Truth, *That all Truth was eternally in, and draws its Nature from the divine Intellect.* Ask me but one Question at once, and try if I can give you distinct Answers.

P. Tell me then, When did those Truths, the Discovery of which you have heard so much celebrated, begin to be Truths?

M. They never had a Beginning, but were always and necessarily true, before they were understood by us; and would be always equally true, though no created Intellect understood them. The Truths yet undiscovered are equally certain, and equally known to an *infinite Intellect*, as when they shall be perceived by Men. The Nature of Truth, or the Certainty of it, does not depend on the Accident of being known by more, or fewer. It is absolute, and above all such Conditions.

P. Has Truth a Nature?

M. What is necessary and immutable, must have a necessary and immutable Nature.

P. Whence doth Truth derive this necessary and immutable Nature?

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M. From the divine Intellect, where it was always known, and always existed. Every Piece of real Knowledge, every demonstrative Truth we come to see, is a Part (so to speak) of that Knowledge which was eternally in the *divine Mind.*

P. Hath Truth no separate Subsistence by itself?

M. It hath not; nor can it have a Subsistence in any Thing *surd*, and *unintelligent.*

P. What is Truth then?

M. It is *Knowledge* or *Science* in the Intellect of some Being. Truth existing in no Intellect, is as repugnant, as Knowledge existing in no Intellect, or Power belonging to no Being. Truth (as I understand from what you said just now) is the Connexion, or Agreement of Ideas; and Ideas cannot be out of a Mind. Eternal Truths, therefore, must always have existed in an *Eternal Mind*; which they thus discover to us, in a Method, indeed, as you observed, most proper to the Nature of the Thing.

LXXXIX. And now, *Philon*, I have not received a more sensible Pleasure from any Thing you have yet shewed me, than from this new Discovery of the Deity. I see as much the Existence of an *Eternal Mind*, of an *Infinite Intelligence*, as I see that Truth was before I was born, or before the first Man was created. This is a Demonstration of the Deity, as an *infinitely knowing Being*, which the Mind of

of Man draws from nothing from without, from nothing in the visible Frame of Nature, but only from its inward Perception of Truth. The Method from the *human* to the *divine Mind* connects the Soul of Man immediately with the Deity. These eternal Truths are to our intellectual Nature, what the visible Wonders in the Heavens or Earth are to the Eyes. What a Pleasure is it to reflect that our real Knowledge is a Part of the Knowledge in the divine Intellect!

P. Consider from this then, *Matho*, how blame-worthy those Men are, who have endeavoured to persuade the World, that there is not a *governing Mind*, a *supreme Intelligence* in Nature; who acknowledge only the blind Force of inert Matter in all the Wonders of Wisdom and Knowledge we observe; and to veil their Perverseness, speak of *Dame Nature* as a Deity, which by an equivocal Sound, takes off the Absurdity to the Ear.

M. Since the Power of a dead Substance is a Contradiction, this is throwing off both *infinite Power* and a *governing Mind* at once. It would be a wretched Sovereignty, if (as those People seem to intend) Man was the supreme intelligent Being in the Universe! But what Madness possesses miserable Mortals, that they should endeavour to persuade their Fellow-creatures, that this World is the Off-spring of Chance, without a Being of infinite Perfections to govern the whole! Can it be against any one's Interest, if infinite Power, directed

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by infinite Wiſdom and Goodneſs, ſhould rule the Univerſe and the Affairs of Men! Is it not rather a Proſpect full of Comfort and Security, to find the Deity at the Head of Nature?

P. Eſpecially if we conſider, that without this Proſpect, there could be no Pleaſure nor Tranquillity in the Life of Man. A confirming ourſelves in ſteady Deſpair would then be our only Hope, and the Loſs of Being our only Relief from conſtant Terrors: For who could be ſecure amidſt the Storms of unguided Matter, and exiſting only at the Diſcretion of Chance? Men have thrown Life away, when they imagined it contained more Miſery than Comfort; which as they could only have imagined on this Suppoſition, ſo on this Suppoſition no Man could imagine otherwiſe.

M. But with what View do they endeavour to bring Mankind under ſuch a wretched and comfortleſs State?

P. They were reſolved to acquire Fame and Repute to themſelves, let the State of Mankind be as wretched as it pleaſed.

M. To acquire Fame by denying a Deity!

P. When a Man's firſt Paſſion, *Matho*, is the Deſire of being ſpoke of, and when he deſpairs of being diſtinguiſhed for any laudable Attempt; this he lays hold of as a compendious Way of attaining his End. The Generality of Mankind believe, and revere a Deity; and only a *fine Genius*, forſooth, can deſpiſe both a Deity and Mankind.

M. De-

M. Detestable Fury!

P. If it were possible, *Matho*, that ever any Man since the Beginning of the World, had denied a Deity from the Conviction of his own Arguments, I should not ascribe their Impiety to this Passion.——Yet they pretend, for Decency's Sake, by denying a Deity, to support the Cause of Truth.

M. That is full as ridiculous, as the other is impious! What have they to do with Truth, after denying the *infinite Intelligence*, the only Source whence it can be derived? Pray, in what do they place the Nature of their Truth? In the Inconstancy of Chance? Or the Inactivity of Matter? Or in the infinite Abyss of Emptiness?

P. It would surprize you more to tell you, that some of them have pretended the great Advantages of Atheism to Mankind; but it is needless, if not ridiculous, to look for Consistency in their Schemes: Leaving them therefore to the Contempt they merit, tell me,

XC. Since the Deity depends on no superior Cause, or since his Existence and Perfections are necessary, can any Thing be wanting to him, which can belong to a perfect and happy Nature?

M. This Question has been answered in Effect, I think, from many Things that have been said already. A Necessity of Perfection implies infinite Perfection; and infinite Perfection, infinite Happiness. It was thus we saw

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his infinite Goodneſs; becauſe, by a Plenitude of Perfection, he is infinitely raiſed above all Wants.

P. From this it will follow, that the Happineſs of the Deity and *that* of his Creatures are of a different Nature: *Our* Happineſs conſiſts in having our Wants ſupplied: *His*, in in having no Wants to be ſupplied. Hence this delightful Truth, the Creation of a World (ſince it could not add to his Happineſs) is entirely owing to his Goodneſs: Or the Happineſs of his Creatures was his only View; and his Deſigns cannot fail of attaining their End. ——But, to conclude, how will you ſatisfy yourſelf in all Time coming, that *God is*, and *is ſuch a Being?* For it is one Thing to ſee a Truth, and another to retain an habitual Knowledge of it afterward.

M. I will call to Mind the ſeveral Reaſons, which force the Mind to acknowledge a Deity, and the Perfections of his Nature.

P. I mean, how will you come at a ready View of this at any Time, without entering into a long Train of Reaſoning?

M. I will look to the Heavens, or to the Earth. A Glimpſe of the Sun or Stars, any living Creature, any vegetable Being, will kindle up the whole Train of Thought in my Mind. I will conſider my own Body, or a Part of it. There, though I do not ſee the Deity with my Eyes, I cannot help perceiving his Power working a thouſand Ways. How can I loſe Sight of the Deity, when the Conſiſtency

sistency and Preservation of all Things, *above*, *below*, and *round* me, nay in the very Body, shew him constantly supporting and directing that very Particular, to which I point my Thought.——Though I abstract from all material Things, if I call to Mind any *immutable* and *necessary Truth*; in that I shall perceive (if I durst so express myself) the *divine Intellect*. In a word, since I cannot withdraw myself from his Presence, nor from amidst the Operations of his Power; I must find God, *powerful* and *wise*, and *good*, in every Thing I either look at or reflect upon.

P. Can any one doubt then, Whether God *be*, because he does not discover him with his Eyes?

M. Such a Man must doubt for no other Reason, but because he had no Reason to doubt. If the Deity could be discerned with bodily Eyes, which are designed for the Perception of corporeal Objects, he would not be that *necessarily existing*, *infinitely perfect Being*, whose Nature constitutes our Happiness. The Soul itself, of the Existence of which we cannot doubt, since our very Doubting proves the Thing, is not thus to be perceived. He who doubts whether the Deity *be*, because he does not see him, ought to demand a Sight of his own Soul, in order to be satisfied that he is a living Being. We see the whole Frame of Nature contrived by his Wisdom, and supported by his Power: This is the fullest, the strongest View, the Heart of Man can desire!

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P. You expreſs the Thing well. The Man knows not what he would have, who complains for Want of this Sort of Proof, for Want of ocular Demonſtration: We have it in the ſtrongeſt Manner poſſible. For while we look at any Thing which the Eyes can perceive, we behold that very Thing, which unleſs the Deity were, could not be. So impoſſible is it to ſee any Thing, which doth not ſhew us the Creator of Heaven and Earth! We are *Eye-witneſſes* every Moment of the *Operations* of his Power, while his Knowledge *guides* the Motions and Productions of Nature. He doth not only preſide over the Main of Affairs, and manages inferior Things by a delegated Power; as ſome inconſiſtently imagine: No he informs the meaneſt *Reptile* by his Wiſdom, to all the Ends of its Exiſtence; he conducts every Herb, every Plant of the Field to its ſpecifick Perfection; and directs all the Motions in the Heavens, and all the Changes on the Earth.

M. It would, in Truth, be extremely fooliſh in us, after we were forced to allow that he binds together by his Power the ſolid Subſtance of Matter, to deny that he conducts the Inactivity of it, in all the Changes it undergoes. It was thus you diſcovered to me the Origin of Motion. The various Exertion of the ſame Power, which binds together the ſolid Subſtance, moves it.

P. They who would place the Dignity of *almighty Power*, and *infinite Knowledge*, in Eaſe and

and Inactivity, seem to have their Thoughts on some *Eastern Tyrant*, while they are speaking of the Deity; and measure his Happiness by their own Nature, and want of Power.

XCI. And now, *Matho*, we have brought the Subject of our Conferences to a Close; having observed what was most necessary and obvious, concerning the material Universe, the Souls of Brutes and Men, and concerning the *adorable Deity* himself. I cannot be of any farther Service to you, nor can we leave off at a more proper place.

M. Nay, *Philon*, I beg you would not think of that so soon. There are still some Particulars concerning the *Motions of the Planets*, which I would fain understand in some Degree; and in those Matters I can do nothing by myself. Besides, some Things you know in our former Discourses you referred to a more proper Place.

P. You do not consider, *Matho*, that the longer we continue our Conferences, the more Things we must refer; in which, perhaps, I can give you no Satisfaction at last.

M. Let us at least converse on those Subjects: For I have observed all along, that while you are speaking on any Thing, many Thoughts offer to me, which would not have otherwise occurred.

P. This is generally the Case, when two Persons converse together with Openness and Friendship. By endeavouring to unfold our Difficulties,

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Difficulties, we sometimes discover the Reasons of Things we were ignorant of: And in this View only can I pretend to talk on those Subjects with you for the future.—— But I cannot help being surprized, that at an Age when others amuse themselves with Trifles, you should so warmly pursue these severer Enquiries, in which you must certainly find no small Difficulty.

M. Shall I freely tell you, *Philon*, what I have hitherto observed in the Course of my Education?

P. With all my Heart. I shall be pleased to hear your Observations; they must be somewhat singular, and entertaining, I suppose.

M. The Subjects we have touched upon, seem scarce to have any Difficulty, in Comparison of those Things, which are forced upon us, almost when Infants. What can be more hard and unintelligible to us, than to hear of the different *Declensions* of *Nouns*; the *Moods*, *Tenses*, and *Conjugation* of *Verbs*; with *Genders*, *Cases*, and the rest of that Stuff? In the Subjects we have hitherto spoke of, Reason convinces and satisfies the Mind, and Truth rewards it with Pleasure: But in the first Beginnings of *Language* and *Grammar*, every Thing is horrid, rough, and really terrible to a Child. Instead of Reason, we are told of *Authority*, and the *Rule of Custom*, which has often both approved, and condemned the same Forms of Speech, as new Modes of Expression prevailed. I wish

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our *Parents* and *Masters* would consider how consistent it is to be so severe with us when Infants, and to spare us so much when more advanced. It looks as if they thought the Art of Speaking, or rather, the Knowledge of Words, was preferable to the Art of Thinking. We are lashed into the Knowledge of a Heap of Words, and after that left to our own Discretion, to think rationally, or otherwise, as we have a Mind, or rather, as it happens.

P. But still you must allow, *Matho*, that Children may learn to speak, before they can think to Purpose.

M. Can they speak to Purpose, before they think to Purpose? They may prate, before they can think to Purpose. And why do they not learn to prate *Latin* by the Ear, as they do *English?* They would acquire this in less Time, than they are now in preparing the Way to it. I have heard good Judges say, that a Boy may learn more *Latin* in two Years, in a Place where it is constantly spoke, than in four, by the stiff formal Method of Rules, without that Practice. From the Restraint we are under lest we should talk false *Latin*, we never acquire that ready Command of the Language, which might be easily attained by speaking it. Before we understand a plain familiar Style, we must be let into the Beauties of poetical Diction. Great Pains are sometimes taken to point out to us the lofty Sentences in our Authors, when perhaps

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haps we ought not so much as to have heard of the Things, which those Sentences contain. Is not this shewing a very partial Regard to Sound?

P. I own, if that be the Case, the Pains taken seem to be misplaced.

M. Is it not the Case? What Boy is not taught with great Pomp,

Ille Pater, Rectorque Deûm, cui dextra trisulcis
Ignibus armata est, qui nutu concutit orbem,
Induitur faciem tauri, mistúsque juvencis
Mugit, &c.

Here is a notable Contrast, as I take it, between the Absurdity of the Sense, and the Sublimity of the Expression; nor are the Passages of this Sort few in Number.

P. I fancy, *Matho*, it would be agreeable enough to hear your Criticisms on the Books you have read: Pray which are your favorite Authors?

M. I don't pretend to Criticism, though I know what pleases myself. It appears to me, that the Historians may be read with Pleasure and Profit. I have read *Cæsar*, and some Books of *Livy*, with Satisfaction; and the lesser Authors that are put in our Hands before these. The short Lives of *Cor. Nepos*, seem to me well fitted for Children: Nor do I find so much Fault with *Justin*'s Want of Chronology, as is generally done. Boys rather mind

mind the Thread of the Narration, than the Distinction of Years: Let that be as it will, a little Pains of the Master would make that a useful Book. The fixth Conference.

P. You say nothing of the Poets.

M. I have but little to say of them: What does it concern me to know whether *Alexis* was *Pollio* or *Mecænas*'s Boy? Or who he was? I should have been at no great Loss, though I had never heard of him.

P. I agree with you; we can reap no great Profit from a Thing, which we must be cautioned against, lest it do us Hurt.

M. That brings to my Mind the *Silenus* of the same admired Author; the safest Way of explaining which to a young Lad, I think, is to leave him ignorant of the Sense.

P. That is a new Way of explaining Things!

M. Consider the Story of *Pasiphae*, which the Poet dwells upon with nauseous Length, and seems to leave unwillingly, and tell me whether you are not of my Opinion?

P. I am not so ready in these Things as you.

M. And then I dare say the School-boy who understands

——uti magnum per inane coacta
Semina terrarumque, animæque, marisque fuissent——

will be in a fair Way to understand as difficult Things as any we have yet spoke of I

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am sure I plagued both my Master and myself heartily about it, with no great Satisfaction to either of us. And pray, *Philon*, is it not strange, that while they think us capable of entering into these Things, they should think us incapable of the least Grain of Truth, or rational Principles?

P. But every Thing is not so exceptionable, as the Passages you have cited.

M. A notable Recommendation, That every Thing is not so absurd! If every Thing that is exceptionable were taken out, (so far as I have read, or am capable to judge) there would be great Chasms, I'm afraid, in the ancient Poets.

P. How comes it then, *Matho*, that those Authors have been the Admiration of the World for so many Ages? And that the most perfect Moderns are only so far tolerable, as they imitate those ancient Writers?

M. Let them have been the Admiration of Men as much, and as long as you please; you will hardly persuade me, that Boys should be taught every Part of them indifferently, or can understand many Places that are commonly taught: And if I were a Man, I think I could find other Things to admire. Truth charms in any Dress; take the shining Passages you admire most, put them in other Words, and all you admire is gone. The *Ancients*, without Doubt, understood the Art of Writing, and were well acquainted with the Influence that Sound and Cadence has on the Affections of the

the Heart, and Passions of Men. But were it not worth while to caution young Lads with Respect to this Art, that it is an Edge-tool, and may be equally applied to a good or a bad Purpose? And to point out the Passages where the Ancients have abused it? It is not a very easy Thing to admire the Expression, and have a just Contempt for the Thought. Let a Man first convince the Understanding, and then raise the Passions on that Side, as much as he can: But to draw the Affections to one Side, when Sense and Reason persuade us on the other, is both hurtful and ridiculous. And I would ask you one Question, *Philon*, Whether the excessive Veneration for those Compositions has not hindered Things of greater Moment from being applied to as they ought? Or whether these are not the only Books recommended to the Admiration of yound Lads? Every one affects to find out new Beauties in them, and to be a Person of superior Taste; as if every Syllable contained a Treasure of Mystery.

P. You are growing warm, *Matho*; take Time to cool a little.

M. I can think for myself in these Matters, without envying other People their Admiration of Sound, or troubling them with my Notions: But you desired me to speak my Mind freely. However, I shall have done, after observing that it seems to me, from my own Experience, a wrong Method to confine us to the Study of Words so many Years; postponing

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ing the Conſideration of Things, and thoſe abſolutely neceſſary, to the laſt Day of our Lives perhaps: For unleſs our Minds are early tinctured with the firſt Principles of true Philoſohy, together with the Knowledge of Letters, (which I conceive may be done by Way of Recreation, and diverſifying our other Buſineſs) it is poſſible that the greateſt Part of us may never have another Opportunity to hear of theſe Things; or none, at leaſt, ſo fit: Since we dwell on Language ſo long, and commence Men ſo ſoon.

P. Some of your Obſervations, *Matho*, are not amiſs; but all that concerns private Perſons, is to purſue the Method they think moſt rational.——You have fatigued me as much, as you did your Maſter, on the Explication of the *Epicurean* Formation of the World: I muſt therefore beg a Reſpite.

M. I willingly agree to it.

The End of the Firſt Volume.